STUDIES ON THE MORPHOLOGY AND BIO-ECOLOGY OF NEMATODE FAUNA OF REWA

Professor W. A. Nizami
Collection

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BY

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ZOOLOGICAL RESEARCH LAB

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CERTIFICATE

Shri Manoj Kumar Singh, Research Scholar, Department of Zoology, Govt. Model Science College, Rewa has duly completed this thesis entitled "STUDIES ON THE MORPHOLOGY AND BIO-ECOLOGY OF NEMATODE FAUNA OF REWA" under my supervision and guidance

He was registered for the degree of Philosophy in Zoology on Jan 11, 1993.

Certified that -

1. The thesis embodies the work of the candidate himself
2. The candidate worked under my guidance for the period specified by A. P. S. University, Rewa.
3. The work is upto the standard, both from, its contents as well as literary presentation point of view.

I feel pleasure in commending this work to university for the award of the degree.

Forwarded
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DECLARATION

The work embodied in this thesis is original and was conducted druing the peirod for Jan. 1993 to July 1995 at the Zoological Research Lab, Govt. Model Science College Rewa, (M.P.) to fulfil the requirement for the degree of Doctor of Philosophy in Zoology from A.P.S. University, Rewa (M.P.), India.

This work has never been submitted in part or in full, to this or any other university for any degree or diploma.

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PREFACE

The present work is being submitted for fulfilment of requirement for the degree of Doctor of Philosophy in the Faculty of Life Sciences in the Awadhesh Pratap Singh Vishwavidyalaya, Rewa (M.P.) India under the head **"STUDIES ON THE MORPHOLOGY AND BIO-ECOLOGY OF NEMATODE FAUNA OF REWA".**

The nematode parasites besides responsible for morbidity and mortality in human, causes considerable loss of livestock, agriculture, dairy products and protein food through affections of plants and animal population. They damage plants and animals directly sucking sap and inflicting injuries on the point of attachment. The plant nematodes are extremely polyphagous and very destructive pest infesting wide range of host plants. They are also reported as vector of over hundreds of viral and bacterial diseases of plants. However, studies of these pests, which is grown in this region since time immemorial and which has now become indigenous, have not yet been carried out in Madhya Pradesh particularly in Rewa. Therefore, the author has taken this work to explore the nematode fauna of Rewa with their bio-ecology for a better understanding of these pest in planning out effective control measure.

In the present study efforts have been made to identify most of the nematodes upto the species level so that it will not only fill up the earlier gaps but also provide most authentic record of the fauna of this region. The new species encountered during the survey have also been described.

It is first attempt to explore the nematode fauna presented in the form of thesis not only for A.P.S. University, Rewa but other universities of Madhya Pradesh. Therefore, the author has given a detail methodology of extraction of nematodes from soil, plant and animal materials. The techniques of killing, fixing, and temporary preparation of parasitic nematodes are especially useful guide for students and workers in nematology. Identification of ecto and endoparasitic nematodes is emphasized by detailed descriptions of their morphology. The author has prepared temporary glycerine mounts by two methods viz. Slow method of Goodey, J.B. (1957) and Rapid method of Scinhorst (1959) which are most useful for workers of nematology. For the measurements of plant nematodes de Man indices were used.

The thesis has been elaborated in three magnificent sections of different disciplines with 84 illustrations and histographs.

The first section 'A' deals with morphology of five animal parasitic nematode species viz. Procamallanus chauhanensis n.sp.; Camallanus thaparansis n.sp.; Ophidascaris ajgaris Khera, 1956; Oxyspirura mehransis n.sp. and Arthrocephalus herpestis Khera, 1956.

The second section 'B' includes the morphology of seven plant parasitic nematodes viz. Tylenchus rewansis n.sp.; Tylenchorhynchus indicus n.sp.; Pratylenchus thornensis n.sp.; Hoplolaimus indicus Sher, 1963; Helicotylenchus jenkinsis n.sp.; Seineura sasseris n.sp. and Xiphinema basari Siddiqi, 1959.

The third section 'C' covers the Biology of Tylenchorhynchus sp. dealing with cleavage, gastrula and its four juvenile stages. The ecological part reveals the effect of temperature and relative humidity on the population fluctuation of Tylenchorhynchus. These ecological aspect and vertical distribution will provide a better understanding of host parasitic association in planning out effective control measure.

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I am grateful to Dr. H.R. Singh, Prof. and Head of Zoology Deptt. of Allahabad University, for providing me library facilities in the departmental library. I also wish to thank Dr. Y.N. Singh, M.Sc., D.Phill, Professor of Zoology and Dr. S.V. Singh, M.Sc., D.Phill, Prof. of Zoology, University of Allahabad for their held in giving references used in the thesis.

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Finally I will always be grateful to my parents for their understanding and encouragement without which this work would not have been possible.

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CHAPTER 1

Introduction

INTRODUCTION

The nematodes contributes one of the most significant group of medical, veterinary and agricultural importance. The most nematodes are free living, inhabit in the soil, fresh or marine water and others parasitic on animals and plants producing enormous diseases. These diseases are problems of considerable magnitude throughout the world particularly in the countries where domestic animals serves as the principal reservoir of infections. There are ample of reasons to believe that most of the infections and parasitic diseases of human race have originated directly or indirectly through animals though once considered to be diseases of rural and sylvatic environments, the nematode parasite occurs in dense and urban area, where these diseases are associated with pet or companion animals like dog, cat and also with exotic pets such as monkey, reptiles, aves and other animals.

The clinical and pathological characteristics of nematodes have many points in common in both man and animals although the localization of lesions, their incidence and their degree of gravity may vary considerably. These differences are mainly related to the species and immune status of the host and portal of entry of pathogens as well as to the intensity and frequency of the exposure.

The study of morphology of pathogenic nematodes and attempts to establish correlations between these structures and their functions has long led us to the conclusion that nematodes must affect their hosts not only by depriving them of nutrients but particularly by disturbing their normal physiological functions even to the point of producing toxic effects and by causing the breakdown of their defense mechanism.

Extensive survey of animal parasitic nematodes in India has been done by Thapar (1924, 25, 38 & 50) in Fishes, Reptiles and Mammals of Lucknow; Karve (1927, 28, 30, 34, 38, 41 & 44) in Fishes, Amphibian, Reptiles and birds of Lucknow; Bhalerao (1931, 32, 33, 34, 35 & 41) Reptiles and Mammals; Chatterji (1933, 35 & 36) in Lizards; Mirza (1933, 34, 35 & 36) in Reptiles of Hyderabad; Singh (1934 & 48) in birds and Mammals of Hyderabad; Chakravarty (1936, 38, 39 & 42) in Reptiles, birds and Mammals of Kashmir; Agrawal (1938) in Wallago attu of Allahabad; Sarwar (1944, 45, 46) in Mammals; Khera (1954) in Fishes, Amphibia, Reptiles and Mammals of Uttar Pradesh and Ali (1956) in Fishes and birds of Hyderabad.

Plant parasitic nematodes are recognised in the developed countries potentially serious constraints to crop productivity. There is rarely any crop free from nematode attack, whether in the fields, in the kitchen gardens or in greenhouses. These plants parasitic nematodes cause severe damage to cultivated crops. Till now the recognition of nematodes as serious deterrents to crop productivity did not occur in the developing countries like India because of less attention paid by the plant nematologists towards this side. If we are to make our proper contribution to world food problem during the coming years we must have sufficient number of trained nematologists.

In India survey of plant parasitic nematodes started at the beginning of 20th century when Barber (1901) recorded Tea-eelworm from Madras. In earlier survey, however, only the genera of plant parasitic nematodes have been taken into account without making any efforts for identifying the species.

The major genera damaging peanuts are Meloidogyne, Pratylenchus, Belonolaimus and Criconemoides spp. The rootknot nematodes known to damage peanuts are Meloidogyne arenaria, M. hapla, M. javanica. The more important nematode of sugarcane is the endoparasitic lesion nematode Pratylenchus. Lance nematode Hoplolaimus is the next important genus widely distributed in the sugarcane belt of India. Presently 45 species of Meloidogyne causing root-knot have been described throughout the world of these nine species are reported to infest potatoes. The most important species on a world basis is M. incognita followed by M. javanica.

Wheat is a major crop throughout the world agriculture. The species like Heterodera avenae, H. latipous, H. hordecalis are known to be pests of wheat. Rice crop is an important food crop of our country. Several genera like Aphelenchoides, Macroposthonia, Ditylenchus, Heterodera and Hirschmanniella cause loss in the yield of rice in India. Many other important crops like Banana, Coffee, Tea, and vegetable, fruit and related crop, which are important crop of India are damaged by these poly-phagus phytonematodes.

The plant parasitic nematodes are not as host specific as animal parasitic. A single nematode has a wide host range and each parasite may infest almost all the host species. The pattern of life cycle is less variable in comparision to animal parasitic nematodes. The adults are either parasitic or free living but in either case the infective stages are found living freely in the soil.

In India although the science of nematology is in infancy and our knowledge regarding the distribution of nematodes is very limited. Sen (1958) reported a loss of 70% in Chillies, brinjal, tomato and okra from Sabour. Srivastava and Upadhyay (1973) observed significant loss due to *Meloidogyne javanica* in the yield of brinjal. An assessment in Rajasthan recently indicated that *Heterodera avenae* alone causes an annual loss of Rs. 40,000,000.00 in wheat and Rs. 30,000,000.00 in barley due to the molya disease (Seshadria and Dasgupta, 1980). An annual loss of over Rs. 75,000,000.00 is suffered due to the ear-cockle disease caused by *Anguina tritici*. An annual estimated loss of Rs. 20,000,000.00 is being done to the coffeae industry in south India by the root-lesion nematode *Pratylenchus coffeae*. The survey of nematode fauna of Madhya Pradesh has completely neglected up till now. It is expected that large scale of surveys in future would provide sufficient information on host-parasite relationship and enable us to work out the quantum of damage and ensuring loss to our national economy.

The bio-ecological aspects of the nematodes help for a better understanding of the pest in planning out effective control measures. Verma and Prasad (1969) pointed out that high temperature and low humidity appeared to be conductive and optimum for the multiplication of the nematode. Further rise in temperature and fall in relative humidity might have decreased their tolerance to desiccation and thus resulting in the fall of population. The seasonal fluctuation and vertical distribution of nematode populations are important tools for formulating control strategy of these pests.

Little is known about the animal and plant parasitic nematode fauna of Rewa district. Therefore, a thourough and extensive survey of host animals as Fishes, Amphibian, Reptiles, Mammals and plants of kitchen garden, gardens, nurseries and field crops was taken during 1993-1994 to ascertain the nematode pathogens associated with animals and plants in the district Rewa. Although, throughout the years these exceedingly interesting organisms have remained a little known group in the biological complex, principally because of the technical difficulties encountered in isolating and preparing them for detailed microscopic examination necessary in the process of identification.

CHAPTER II

Historical Review

ANIMAL PARASITIC NEMATODE

Although knowledge of animal parasitic nematode warms goes back some 3,000 years, they have been more the concern of physicians than zoologists. One of the first written records of the parasites of medical importance is contained in the Papyrus Ebers (Circa 1500 B.C.) and in it mentioned forms we now know as Ascaris lumbricoides and Dracunculus medinensis but specific mention of forms is absent unless we accept the term "fiery serpents" as a reference to Dracunculus. More definite references to round worms and thread worms can be found in Greek writings; Hippocrates (Circa 400 B.C.) and Aristotle (Circa 350 B.C.) mention them. Nearly all the references to nematodes until the end of the middle ages are concerned with disease and treatment. Avicena (Circa A.D. 1000) recommended enemata for the treatment of the pin worm Entrobius vermiculasis. In the middle of the nineteeth century one important achievement was the discovery by Manson of an insect intermediate host for wucheria bancrafti.

However, it was 1771 when Linnaeus found Trichuris trichiura causing acute appendicitis in man and few years earlier in 1758 he also reported Enterobius vermicularis infecting in human. Leuckart

(1865) first worked out its life cycle. Ancylostoma deuodenale was first discovered in 1838 by a Italian physician Angedo Dubini. Loss in 1898 worked out it pathogenesis and mode of entrance of larvae in to man. The twentieth century has seen considerable advances in clinical method but many of the problems of control are still unsolved. For example, hook worm disease caused by Ancylostoma duodenale and Necator americana still ravages many parts of the world. A picture of the position of infection of nematodes can be gives by looking at estimates made by stoll in 1947 that Trichinella spiralis enfected 28, Dracunculus medinensis 48, Onchocrea sp 20, Wucheria bancrofti and W. malayi 189, Enterobius vermicularis 208, Hook worm 457, Ascaris lumbricoides 644, Trichuris trichiura 356, Strongyloides stercoralis 35, millions of human population.

One of the earliest references to nematodes of specific veterinary interest is that of Hippocrates (Circa 400 B.C.). He reported that horses have been found infected with undoubtedly Oxyuris equi. Aristotle (Circa 350 B.C.) referred to ascardis in dog and Columella (Cerca A.D. 100) recorded an ascarid from a calf, a worm now known as Neoascaris vitulorum. From then until the nineteenth century there were few records of nematodes from domestic animal. Albertus Magnus (Circa A.D. 1200) recorded a worm from a falcon. Caesalpinus (Circa A.D. 1600) described the kidney worm Dioctophyme renale in a dog, this is one of the largest of nematodes found at that time.

Two of the most important discoveries in the field of veterinary helmenthology are those of Leidg (1846) who described Trichinella spiralis in the muscles of the pig and Virchow (1859), who demonstrated its transmission from rat to pig. Virchow, Herbst and Leukart realise the importance of this worms to man and their concern resulted in the beginning of meat inspection. From 1860 on word the morphology, life histories and new genera and species of many important nematodes parasites of domestic animals were worked out by several nematologist and this work continues even today. It is probably in the veterinary field that nematodes have been studied most extensively in the recent years.

The first anatomical study was made by Tyson (1685) who described many of the structures of Ascaries lumbricoides. More zoological work was done when microscopes were made. During the eighteenth century many free living nematodes were recorded and described.

The main anatomical studies began in the nineteenth century and with fading of belief in spontaneous generation, the studies of life histories became of interest to zoologists as well as physicians.

Linnaeus (1758) was the first taxonomist who placed round worm along with many other kind of worm in his book Ststema Nature and mentioned several prominent nematodes genera as Ascaris, Trichocephalus, Filaria, Strongylus and Cucullanus under the group Vermes. The greatest advance in the eighteenth century was made by Goeze, who studied the vinegar eel and other nematodes. Cuvier and Lamarck made some attempts at classifying worms. However, zeder in 1800 utilized Goeze's work and correctly distinguished several types of worms and he gave common names of nematodes which he termed round worms (Round wurmer). In 1793 Rudolphi began to study the parasitic nematodes. He gave them scientific names, calling the round worm Nematoidea. Rudolphi in his Entozoorum synopsis published in 1819 listed 11 genera and about 350 species of nematodes.

No satisfactory place of nematodes has been achieved in the animal Kingdom until 1859 when Gegenbaur in the leadership of Vogt created the class Nemathelminthes under the phylum Vermes. The name

Nemathelminthes won general acceptance, the taxonomists such as Dugardin (1845), Diesing (1850), Bostian (1865) and Schneider (1866) laid the foundations of more modern classification. Anatomical studies progressed rapidly from the end of the nineteenth century, and such workers as Goldschmidt and Martini made notable contributions.

During the nineteenth century parasitic worms were intensively studied under the leadership of Leuckart. Many valuable contributions of the morphology, anotomy and life cycles of parasitic nematodes were made by distinguished helminthologists, as Van Beneden, Blanchard, Braun, Calandruccio, Cobbold, Diesing, Grassi, Leidy, Leuckart, Van Linstow, Looss, Parva, Railliet, Rohle, Schneider, Stossick and Zacharias. The available knowledge to that was assembled by Schneider in 1866 in his well known Monographic der Nematoden.

The free living nematodes, zoologically more important that the parasitic worms, were mostly neglected until nineteenth century, the most important early workers were de Man (Circa 1866) and Butschii (Circa 1875). Our first information on free living nematodes dates from Borellus (1656) who first observed

"Vinegar eels" which were present in practically all vinegar.

Knowledge of free living nematodes were greatly accummulated by the studies of Allgen, Cobb de Coninck, Dadag, Ditlivsen, Filipjev, de Man, Micoletzky, Stekhoven and Steiner. Regarding the study of parasitic nematodes a vast literature has accumulated among the leading contributors to which may be mentioned Alessandrini, Alicata, Ackert, Artigas, Augustine, Cameron, Chandler, Chitwoods, Christie, Cort, Cram, Dikmans, Faust, Hall, Godfrey, Goldschmidt, Goody, Lane, Lucker, Maplestone, Martini, Monning, Rauther, Ranson, Sandground, Seurat, Skrjabin, Spindler, Sprehn, Schwartz, Stewart, Stiles, Stoll, Thorne, Travassos, Yamaguti, Yokogawa, Yorke, Walton, Ward, Zavadovski and Bhaleroa, Chakravorty Chandler, Chatterji, Deo, Khera, Rao, Sanwal, Sarwar, Singh, Shrivastava and Thapar in India.

"Introduction to Nematology" published by Chitwood added greatly an outstanding account of nematodes morphology to our knowledge. A synopsis of the families and genera of nematodes by Baylis and Daubney (1926) and the nematode parasites of vertebrates by Yorke and Maplestone (1926) are useful taxonomic aids.

The progress of Nematology in India may roughly be divided into three phases -- the various phases overlapping one another. In the first phase the material collected in India, Ceylon and Burma found its way into the hands of specialists like Cobbold in England, Railliet in France, Parona in Italy and von Linstow in Germany. In this way many species were described both form domesticated and wild animals.

The second phase began when a few British officers -- mostly of the Indian Medical Service and Indian Veterinary Service -- came across the worms in their routine examination in their respective hospital. Galger (1910 & 1915) published lists of parasites principally based on materials obtained from domestic animals in the Punjab. Lan (1913-21) studied Ankylostomiasis in India and Ceylon and added a large number of species to the nematodes of domestic animals. Stewart (1914) described a number of free-living and parasitic nematodes. Sheather (1919) described a namatode causing parasitic gastritis in calves and later (1920) gave an account of Syngamus laryngeus in Cattle. Boulenger (1920-24) described a number of nematodes of domestic animals in the Punjab.

Ware (1924) reported nematodes from the Indian elephants and later from Cattle. Korke (1924) described a microfilaria from a dog and also redescribed Rudolphi's type species of Spirocerca. Later (1927-33) he made preliminary investigations on Filariasis. Chandler (1925 & 1929) and Maplestone (1930-32) described several forms from the animals dying in the Calcutta Zoo. In this connection Chandler's work (1926-28) on the prevalence and epidemiology of Hookworm and other helminthic infections in India and Maplestone's work (1930) on parasites of pigs deserve special mention. Two collections of materials were sent by the authorities of the Zoological Survey of India to Baylis, who in collaboration with Daubney (1922-23), described a number of forms in two excellent reports. In 1936 and 1939, Baylis summarized our knowledge of the Nematoda in two volumes of the Fauna of British India series. During the same time, Indian workers also took up the study of Nematology. Thus began the third phase in the progress of Nematology in India.

Thapar (1924-25), while in England, described several species of the genus, Kiluluma and further discussed points of general interest in nematodes. In

1925 he described another genus Echinopharynx and discussed its relationships. In his monograph on the Reptilian oxyurids, Thapar (1925) described the presence of cilia, cleared up the confusion that existed between Tachygonetria and Thelandros and erected a new family Labiduridae. He further postulated that the oxyurids were highly specialized nematodes that have secondarily attained simplicity through degeneration. In 1938 be reviewed the progress of Helminthology in India. In 1950 he described two species of Rhabdochona from India and gave a review of the work done in Helminthology in India from 1939 to 1950.

Karve (1927, 28, 30, 34, 38, 41 & 44) described many forms, mainly from Amphibia and Reptiles, Recently, Karve et Naik (1951) described new forms from fishes.

Thwaite (1927) described a number of nematodes from Ceylon.

Mirza (1929) restudies the anatomy of Dracunculus medinensis and from 1933-39 he described a number of new forms in collaboration with Singh 1934; and Basir 1937-39.

Pandit, Pandit and Iyer (1929) described a new filarid genus Conispiculum and studied its development in the mosquito.

Agrawal (1930) described a rather unusual species of Procamallanus from Wallago attu from Allahabad.

Bhalerao (1931-35, 1941); and Bhalerao and Rao (1944) described a few forms mainly from domestic animals and in 1935 published a memoir on the Helminth Parasites of Domesticated Animals.

Verma and Agrawal (1932) described a species of Spinltectus from piscine host.

Chatterji (1933-36) described a number of nematodes from reptiles and birds.

Singh (1934) described the genus, Gastronodus from the grey musk-shrew and in 1948 added a number of species to the nematode fauna of birds of Hyderabad.

Patwardhan (1935) described an oxyurid from a squirrel and studied the nematodes from the common wall-lizard, Hemidactylus flaviviridis.

Pandey (1936) described Stephanofilaria assanensis from the humpsore of Cattle in Assam.

Chakravarty (1936-42) in a number of communications, described a few nematodes from various groups of vertebrate hosts. Chakravarty and Bhaduri (1948) described an oxyurid genus, Neopharyngodon, from Gekko gecko.

Moorthy (1937-38) recovered a number of new nematodes from the fishes. He (1938) also described the life cycle of Camallanus sweeti Moorthy, 1937.

Basir (1940-42 & 1948-49) described a number of nematodes from invertebrate and vertebrate hosts and also gave a technique for the study and manipulation of nematodes.

Sarwar (1944-46) added to our knowledge of nematodes parasitic in domestic animals in the Punjab.

Sanwal (1951) described two species of nematodes from birds.

Khera (1951) described two species of nematodes from reptiles and two species from mammals. He has described two gener , one genus from a fish and the other from a bat. in 1953.

Stray papers have also been published, Menon and Iyer (1929); Roy Chaudhuri (1931), Rabimullah and Das (1933), Ray and Das Gupta (1933), Datta (1933) and Lal (1942, 44). Ali (1956) described two new genera Neocamallanus and Indocucullanus and fourteen new species from fishes & birds with a key to the species of genus Spinitectus from Hyderabad.

PLANT PARASITIC NEMATODE

Filipjev and Stekhoven published a mannual of agriculture helminthology in 1941 which contains valuable general information regarding phytoparasitic nematodes. The beginning of account of phytonematodes has been made by Stekhoven (1935) in Bronn's Klassen and ordnungen des Tierreichs which includes a useful bibliography of about 8000 titles. Other helpful accounts are those of Baylis in the Fauna of British India, Rauther in the Handbuch her zoologic and Wiilker and Steckoven in Dic Tierwelt der Nordund ostsee.

The first record of plant parasitic nematodes in 1594 we find when William Shakespeare wrote the line "Sowed Cockle, reapud no Corn" in Love's Labour's Lost, Act IV, Scene 3. One hundred forty nine years after, Turbevill Needhan (1743) discovered the riddle of the 'Cockle' when he crushed one of the shrunken, backened Wheat grain and placed in water. This was the first demonstration of *Anguina tritici*. Linnaeus (1767), Scoponli (1777), Steinbuch (1799) and others recorded the some species and noted that it also attached other cereals. Schmidt (1871) recorded nematodes sugar beet pest *Heterodera schachii*, and Strubell (1888) presented a detailed morphology of the species. Barkeley (1855) had observed 'Vibrios' from galls on the roots of cucumbers in England. Greef (1872) found *Anguillula radicicola* = *Ditylenchus radicicola* farming galls on the roots of *Poa annua* and other grasses. The first root-knot nematodes *Meloidogyne marioni* was described in the galls on the roots of *Onobrychis sativa*. Goeldi (1887) published a description of *M. exigba* producing galls on the roots of coffee in Brazil. Marcinowski (1909) published on excellent work in her book parasitisch und semiparasitisch and pflanzen lebenden Nematoden which includes her original research works.

Meantime, free living nematodes had been found in fresh and marine water by Miller (1786), Bory (1824), Dujardin (1845), Carter (1859) and Eberth (1863) who gave the first discription of the gross anatomy of these interesting little nematodes. Bastian describe 100 new species belonging to 30 genera of which 23 were new and his "Monograph of the Anguilluidae" (1866) marked the begining of the science of nematology. Otto Biutschi

(1873) gave us first detailed descriptions of the morphology of free living nematodes. Oreley (1881) made an excellent compilation of information on 202 species, representing 27 genera of free living and plant parasetic nematodes. Micolezky (1922) compiled all the literature on soil and fresh water nematodes in "Die freilebende End Nematoden".

An interesting series of papers appeared by Gilbert between 1914 and 1938 dealing with nematode parasites of bark beetles. Fuchs a forest entomologist discovered numerous species of Tylenchoidea, Aphelenchoidea and Rhabditoidea including several new genera. In 1934 Filipjev produced his book "Nematodes that are of importance for agriculture". The translation was published in 1941 under the title A Manual of Agricultural Helminthology Research papers on plant parasitic nematodes were published by Bovien, Carrol, Edwards, Franklin, Goffart, Korab, Ritzema Bos, Van Slogteren Staniland, Triffit and numerous others. A summary of these papers on nematodes parasites of cultivated plants was presented by Goffart (1951) in "Nematoden der Kulfurpflanzen Europas".

In England Tom Goddy published his first paper on nematodes in 1922. Thereafter numerous papers appeared in rapid succession culminating in his book "Plant parasitic Nematodes and the Diseases They cause" (1933). Following the publication of this volume Goodey began assembling a second book "Soil and Fresh Water Nematodes" which appeared in 1951.

In united states Leidy (1851) reported certain observations which constitutes the first record of free living nematodes in America. He described *Anguillulula longa*, *A*. *longicauda* and *A*. *fossolarius* as n.sp. Root-knot nematodes, Meloidogyne sp. Were the first plant parasitic species recorded by May in 1988 in United States. Atkinson and Alabana in 1889, Halstead (1891) and Stone and Smith (1898) made extensive research work on morphology, host ranges and crop damage by these pests and published the results of their observation.

Cobba's first paper on plant parasitic nematodes "Tylenchus and Root Gall" appeared in the "Agricultural Gazette of New South Wales" (1890). His first paper "New Nematodes Genera Found Inhabiting Fresh Water and Non brackish Soil" was published in 1913. Among his writings "Contributions to a Science of Nematology" is the most out standing works. His laboratory manual "Estimating the Nema population of Soil" (1918) formed the basis of research in nematology. Bassey the associate of Cobb working on root-knot nematodes, the review (1911) of his principal work still remains one of the out standing contribution to our information on this group.

The most important index to species of nematodes is that of Stiles and Hassall which is issued in 1920 under the title "Index Catalog of Medical and Veterinary Zoology, Round Worms". Working with Cobb, he Collaborated on morphology and taxonomic problems of nematodes.

Other members working on nematology in United States were Christie, Steiner, Chitwood, Taylor, Godfrey Buhner, Courtney, Carter, Byass, Milbrath, Lenkel, Linford Waston, Newhall, Baker, Newton, Hastings, bosher, Who's contributions are outstanding in the field of nematology.

Among the outstanding work published during these years is "An Introduction to Nematology" by Chitwood brothers having detailed morphological studies of supergeneric groups with illustrations and principal diagnostic characters of families, genera and species. Christie (1959) published and excellent valume

"Plant Nematodes, Their Bionomics and Control". With the discussions on life history, feeding habits, distribution and control of nematodes.

The history of nematology would not be complete without an inclusion of work of Azmi & Jairajpuri (1978), Bajaj & Bhatt (1983), Bajaj & Jairajpuri (1976, 77 & 79), Banerji & Banerji (1966), Bagri & Ahmad (1981), Bagri & Jairajpuri (1969 & 70), Gaur & Mishra (1981), Gupta et al (1967, 80, 81), Jairajpuri et al (1971, 73, 80), Khan (1964, 81), Rashid et al (1974, 78, 82), Sher (1961, 63, 66 & 74), Siddiqi (1959, 61, 63, 64, 70, 71, 72 & 76) and Singh (1971, 74 & 77) of Indian Plant Nematologists.

CHAPTER III

Material and Methodology

COLLECTION OF HOST

Animals and plants materials were collected from various Tahsil and neighbouring of Rewa district of Madhya Pradesh for parasitic nematode study. It was observed that vertebrate animals, vegetable, careal, ornamental and other plants of economic importance, were mostly infected with nematodes. Heavy infection of animal parasitic nematodes was observed in rural and sylvatic region where there is maximum pollution and ill conditions prevals. Whereas infection of phytophagus nematodes was observed in soil regularly kept moist and manured with cow dung.

The plants and vertebrate hosts Fishes, Amphibia, Reptiles Aves and Mammals were collected from important places of various Tahsils of Rewa. Soil and root samples were obtained at a depth of at least one foot arround annual plants. For shrubs and trees it may be 2 or 3 feet. For the study of endoparasitic nematodes, plants uprooted, roots were washed in tap water and cut into pieces, teased and examined under binocular microscope.

For ectoparasitic nematodes, soil washings were also examined under binocular microscope. The Cobb's sieving and decanding method was used for separating nematodes from soils. In the same way intenstine of host animals cut open in saline and examined under binocular microscope for the study of animal parasitic infection. During the practical work it was observed that many genera of plant and animal parasitic nematodes, like Aphelenchus, Hoplolaimus Tylenchorhynchus - could be kept alive for several hours in tap water.

(C) EXTRACTION OF FREE LIVING NEMATODES FROM SOIL

For active and motile nematodes, Baermann funnel techniques (Baremann, 1917) is used to separate them from inert debris. The funnel is place in a support and filled with tap water. Finely crumbled soil, plant tissue cut into small pieces is placed in a square of butter muslin which is folded to enclose the material, then gently submerged in the water in the funnel. Active and motile nematodes pass through the cloth and sink to the bottom of the funnel stem. After some hours or over night a small quantity of water containing the nematodes is take off.

Cobb (1918) decanding and Sieving method is also tried to gain a general idea of the nematode fauna in a sample. The range of sieves apertures 1 mm., 710 , 250 , 150 , 90 , and 63 is usually used, through which a soil suspension is poured serially. Place the soil or soil with roots in a container (i) of greater diameter than the sieves to be used, and cover with water.

After soaking break any lumps gently with the fingers and remove stones and other debris. Pour it through 1 m. aperture sieve into a second container (ii) and leave behind the settled heavy material. Add more water to the residue and repeat the process to obtained an optimum yield of nematodes. The remaining portion should be discarded and wash-out container (i) Rinse the material on the sieve either with a gentle-jet of water so that the washing are collected in container (ii).

After stirring the contents of container(ii), pour them through the 710 aperture sieve into container (i), again leave behind the heavier debris. Rinse the sieve as before, then was the residue on the sive in to a 250 ml. beaker. Clean container(ii) and repeat the operations with the remaining sieves, collect the sievings each time in a appropriately lablled beaker.

Allow the contents of beakers to settle for 2 hours or more. Pour the excess water and transfer the remaining contents. However, Nematodes suspensions in water are mixed with debris it will be separated by pouring it on a doubled piece of paper tissue is placed on the sieve. The nematodes are at first retained on the sieve which is then placed in clean water in a small dish. The whole is left undisturbed for over night, the nematodes wriggle through the filter and collect in the dish.

EXTRACTION OF NEMATODES FROM PLANT MATERIAL

Plant material containing nematodes should be kept cool and moist and examined as soon as possible. The plant parts are best stored free from soil. The shoots often decompose more quickly than roots so they should be kept in separate bags if stored for more than a day. Polyethylene bags are excellent containers for samples.

Direct examination and testing of the nematodes from plant tissue is frequently used when the sample is small or in studying a perticular suspect host. First wash the roots gently to remove as much soil as possible. Examine the tissue in water in an open petridish and it with stout needles. Nematodes released from the tissu float out and can be collected with handling needle.

Baermann-funnel technique is used for the extraction of active and motile nematodes. The material is chopped and placed in muslin or on a supporting sieve which is immersed in water in a funner or other suitable container. Active nematodes pass through the cloth and sink to the bottom of the funnel stem. After some hours of over night, a small quantity of water containing the nematodes is run off.

Root-incubation technique is also applied for the extraction of migratory endoparasites. Roots are washed free from soil and cut into lengths of 5-10 cm., The fleshy roots can be split longitudinally to help nematodes emerge. The roots are put into containers such as screw cap Jars, closed Petri-dishes or sealed polyethylene bags and kept at 20-25°C. The roots are well wetted or immersed in shallow water before the containers are closed. If the roots are immersed it is advisable to pour off the water and rinse the roots after 24 hours, retaining the original water and washings for examination. The extraction can be continued by adding more water and reclosing the container. Most of the nematodes are recovered with in 4-7 days.

EXTRACTION OF NEMATODES FROM ANIMAL HOST

Nematodes are extracted from animal tissues by reducing the tissue to small pieces by mechanical cutting with the help of scissors, blade or scalpel. Separation from the tissue is also done by the addition of various digestive material (Hertich, 1956) to make easir the liberation of the nematodes as the result of their own actions.

Sometimes direct searching of tissues is desired and necesary. The intenstine should be cut into small pieces and open longitudinaly with the use of forceps and scissors. Small lengths of intestine were everted along the length so that the inner layer was thus exposed. These small pieces of exposed intestine requires scrabbing and scusing vigorously with the help of forceps to separate the nematodes from the mucosa of intestine.

McGee et al. (1957) put these expose pieces of intenstine into a wide petridish, covered with saline or 1% HCl and placed in an incubator at 45°C for 5-10 minuts. Irritated by the heat and acidifind medium, the nematodes leaves the muscosa.

TEMPORARY PREPARATION

The individual speciman are usually selected from a suspension using a handling needle. The pipette may be used picking up small batches of nematodes. Some structures are more easily seen in live, stationary, nematodes than in dead, fixed or processed specimens. It is therefore often worth making and studying temporary mounts of live specimen. A weak solution of dichlorodiethyl ether can be used to immobilize nematodes. Add two drops of ether to 50 ml of water and shake well. Enough of the ehter dissolves to make a solution which will immobilize nematodes and mounted in it. They recover when placed in fresh water or they can be killed and fixed for subsequent processing and mounting.

Many valuable observations can only be made on examining temporary mounts of living, narcotized specimens. The refractive structures such as the spear, head skeleton lumen of oesophagus, excretory pore, spicules etc. are much clearer than when they have been fixed for some times of processed to glycerol.

Place one or few specimens with a drop of water on the glass slide. Add three pieces of glass fibre of thickness similar to that of the nematodes. Arrange the fibres radially near the edges of the drop. Put the coverslip gently and attach the coverslip at three point with nail polish or with candle wax. A mixture of 8 parts of wax to 3 parts petroleum jelly is better than ordinary candle-wax for sealing coverslips.

KILLING AND FIXING TECHNIQUES

Exposure of nematodes to gentle heat is used for relaxing nematodes specimens and this method remains the one of the most useful for soil, plant and animal nematodes. The killing and fixing method of Seinhorst (1966) was used for to kill and fix the nematodes. Formal acetic fixative 4:1 is heated to 100°C and 3-4 ml. is quickly added to the nematodes. This method fixes glands and gonades well and nuclei are often clearly visible. Netscher and Seinhorst (1969) obtained better results when propionic acid was used in place of acetic in killing solution of nematodes.

If a few specimen can be killed at a time then they can be heated over a small flame with the drop of water on a plain or cavity glass slide, until the nematodes assume the straight, in some genera or curved or spiral in others. The specimens are immediately transferred to fixative or fixed on the slide by adding "double strength" fixative. Another safer method of killing is to heat the nematodes with water at 65°C for 2-4 min. Until the nematodes are dead. Then add an equal volume of "double strength" fixative.

FIXATIVES

Numerous fixative have been recommended for studying different features of nematodes anatomy. The commonly used fixatives and preservatives are formalin acetic acid (FA), TAF a mixture of formaldehyde and triethanolamine. Formalin - glycerol, FAA, 70% hot alcohol with 3% glycerine and 5-10 percent formalin. After fixation many of the internal details of nematodes especially gonads structure may be obscured by the granular appearance of the intestine. These can be cleared by lactophenol or glycerol which are also suitable mountants.

Mounting in lactophenol is a quicker method and specimen will often last several years if they will kept in light deteriorate gradually. The specimen well prepared in glycerol will keep almost indefinitely and its optical quality is better than that of lactophenol mounted specimen, but processing to glycerol takes longer time. The rapid lactophenol method (Franklin and Goody, 1949) and rapid method to glycerol (Baker, 1953) were used for the mounting of parasitic nematodes, but these rapid methods are not so much useful for fine details of morphological studies.

Permanent mounts of nematodes may be made in lactophenol or glycerol. Glycerol is better because it gives greater clarity, in time lactophenol spoils the mounts. Keep a drop of glycerol of lactophenol in the centre of clean glass slide. The drop will be as convex as possible which helps to avoid air bubbles when the coverslip is added. If nematodes have been stained with cotton blue, the mounting medium should be slightly tinted with .0025% of cotton blue.

Keep the glass fibere near the thickness of specimen on the three sides of drop and transfer one of the nematode with a handling needle to the drop of lactophenol or glycerol on the slide. Arrange the nematode neatly in the centre of drop and asure that specimen is resting on the glass surface not floating in the drop. Arrange the three pieces of glass fibre radially and peripherally at 120 deg. Gently warm a round coverslip over a small flame and apply it to the drop. The warmed coverglass settles over the nematodes and supports more quickly than a cold one and nematodes should not move appreciably in the process.

The mounting drop should be such size that it just spreads to the edge of the coverslip with no excess. The actual size of drop depends on the thickness of the nematodes. Fix the coverslip at three points with small drops of Thorne's Cement applied on the tip of a fine brush. Allow these drop to set and then ring the coverslip with a thick layer of the cement. A second and sometimes a third ring of cement, which may be coloured, should be applied before the slide is finally stored.

PROCESSING

After fixation the author has prepared temporary glycerine mounts by two methods:

1. Slow method of Goodey J.B. (1957)
2. Rapid method of Seinhorst (1959)

SLOW METHOD OF GOODEY 1957

The fixed nematodes were transferred to a cavity block filled with following solution:

Glycerol 1 ml

Ethanol (20%) 100 ml.

The cavity block containing nematodes in the above mixture was kept in a dessicator in which a small bottle containing 96% ethanol was kept open. This filled the atmosphere of dessicator with vapours of 96% of alcohol. The cover of cavity block was slightly removed in order to leave a space for evaporation of alcohol. The atmosphere, saturated with vapours of 96% ethanol, inhibits the quich evoporation of mixture in the cavity block. After some time the water and alcohol got evaporated and specimens were left in pure glycerine.

RAPID METHOD OF SEINHORST 1959

The fixed nematodes transferred to a cavity block containing 0.5 ml. of a mixture of:

Ethanol 96%	20 parts
Glycerol	1 parts
Distilled Water	*79 parts*

The partly covered cavity block, containing nematodes in the above mixture was kept in a dessicator containing a small bottle of 96% ethanol and kept for 12 or more hourse at 35 to 40°C.

After this period cavity block was filled with following mixture:

Glycerine	5 parts
Ethanol 96%	95 parts.

Partly covered cavity block was placed at 40°C until all ethanol got evaporated and specimens were mounted in pure glycerine and cover slip was ringed with nail polish or plastic solution or quick fix.

Male and female genital organs and eosophageal glands are better shown by rapid method but often caused Shrinkage. The slow method gave better general appearance but takes much time. Various structures of nematodes such as spear, head skeleton etc., are best seen in living or freshly killed specimens. It was observed that when a drop or two of a 1:50, V/V solution of saturated aqueous ammonia in water, containing nematodes was added then in some case nematodes were induced to protrude their spears and spicules (Hooper, 1977).

Various measurements were taken from the mounted specimen de Man indices (L, a, b, e, v) and few other indices, which have been adopted from standard works on different groups of nematodes, were used for description of females.

For the vertical deistribution and population studies, soil samples were collected fourtnightly between Jan. 1993 to Dec. 1994 from natural crop field of Teonther Tahsil District Rewa at different depths Viz., 0-10, 10-20, 20-30 cm after dividing a field into five small areas and drawing 250 ml soil from each area. Field soils were Sandy loam in texture. During different periods of sampling soil moisture, and soil temperature were taken. The soil samples were treated by the "Seiving and Baermann-funnel technique" for the extraction of nematodes. After logarithmic transformation, the data were analysed statistically to ascertain the significance of depth and season influencing numbers.

SECTION - A

ANIMAL PARASITIC NEMATODES

TABLE - I

SYSTEMATIC LIST OF THE ANIMAL HOST EXAMINED

S.No.	Name of Host	No.of Host		Parasite recovered
		Examined	Infected	
1	2		4	5
	FISHES			
1.	Ophiocephalus punctatus	4	2	Camallanus sp.
2.	Clarias batrachus	2	1	Procamallanus sp.
3.	Mystus seenghala		2	Procamallanus Chauhanensis n.sp.
	AMPHIBIA			
4.	Rana cynophlyctis	6	5	Camallanus thaparansis n.sp.
5.	Rana tigrina	5	Nil	----------
6.	Bufo melanostricutus	2	1	Oswaldocruzia sp.
	REPTILIA			
7.	Hemidactylus flavoviridis	3	Nil	----------
8.	Calotis versicolor	5	3	Stongyluris Karawirensis karve 1838.
9.	Triopidonotus piscator	4	3	unidentified nematodes

1	2	3	4	5
10.	Kachuga dhangoka	09	Nil	----------
11.	Lissemys punctata	13	Nil	----------
12.	Varanus monitor	2	1	Amplicaecum monitor Khera,1956.
13.	Python molurus	1	1	Ophidascaris ajgaris, Khera,1956
	AVE			
14.	Carvus splendens	8	5	Chandlerella sp.
15.	Bubulcus ibis (Linn)	4	3	Oxyspirura mehransis n.sp.
16.	Passer domesticus	3	Nil	----------
17.	Columba livia	12	Nil	----------
18.	Gallus gallus	7	4	Helerakis indica Maplestone, 1931.
19.	Psittacula eupatria	2	Nil	----------
	MAMMALIA			
20.	Rattus rattus	6	Nil	----------
21.	Herpestes Smithii Smithii	1	1	Anthrocephalus herpestis Khera, 1956.
22.	Capra hercus	3	1	Acanthoxynema sp.
23.	Ovis sp.	2	1	Varestrongylus sp.

SYSTEMATIC LIST OF ANIMAL NEMATODE DESCRIBED

The classification opted here is given by Yamagutti 'SYSTEMA HELMINTHUM' volume III, Part I (1961).

	CLASS	-	Nematoda Rudolphi, 1808
		-	Secernentea (Von Linstow, 1905) Dougherty, 1958 (Syn.-Subclass-Phasmidia, Chitwood & Chitwood,1933).
1.	**Order**	-	Spiruridea Deising, 1961
	Family	-	Camallanidae Railliet et Henry, 1915
	Genus	-	Procamallanus Baylis,1923.
(i)	Species	-	P. chauhanesis n.sp.
	Genus	-	Camallanus Railliet et Henry, 1915 Syn. Cucullanus auctt. nec. Mueller 1777.
(ii)	Species	-	C. thaparanis n. sp.
2.	**Order**	-	Ascarididea n. ord. For Ascaroidea Railliet et Henry, 1915.
	Family	-	Ascarididae Blanchard,1849
	Sub family	-	Ascaridinae Lane, 1922 For Ascarinae Travassos,1913
	Genus	-	Ophidascaris Baylis, 1921
(iii)	Species	-	O. ajgaris Khera, 1956

3.	**Order**	-	Spiruridea Diesing, 1861
	Family	-	Thelaziidae Skrjabin, 1915
	Sub family	-	Oxyspirurinae Skrjabin, 1916
	Genus	-	Oxyspirura Drasche in Stoss, 1897
iv)	Species	-	_O_. _mehransis_ n.sp.
4.	**Order**	-	Strongylidea Diesing, 1851
	Family	-	Ancylostomatidae Nicoll, 1927
	Subfamily	-	Bunostominae Looss, 1911 Syn Necatorinae Lane, 1917.
	Genus	-	Arthocephalus Ortlepp, 1915
V)	Species	-	_A_. _herpestis_, Khera, 1956.

.....:.. ....:

CHAPTER IV

Procamallanus chauhanensis n.sp.

PROCAMALLANUS Baylis, 1923

The genus procamallanus was established by Baylis (1923) for P. laeviconchus (Wedl, 1862) as its type. While creating the genus he also described a second new species from a siluroid fish in Africa. The third species of the genus, P. parasiluri was described by Fujita (1927) from Japan, again from the siluroid fish. Travassos (1928) added three more species to the genus, namely P. inopinatus, P. iherengi and P. rarus from siluroid fishes in Brazil. Baylis (1929) discovered another species, P. xenopodis from a batrachial (Toad) in Egypt.

Agrawal (1930) reported P. mehrii from an Indian siluroid fish. Tornquest (1931) prepared a monograph on Cucullanidae and Camallanidae, in which the author revise the genus and added one more species P. sphaeroconchus from a siluroid fish in Europe. Viz and Pereira (1934) recorded two species, P. hilarii and P. amarali from fish of Brazil. Pearse (1935) added another species, P. kerri from a Siamese fish basing his description on a single female. In the same year six more species were added to the genus; three of these P. wrighti, P. fariasi and P. barroslomae by Pereira from Brazil; P. sigani by Yamaguti from Japan;

P. fulvidraconis by Li from China, and P. planoratus by Kulkarni from India, all from siluroid fishes.

In the subsequent year, Pereira added one more species P. crearnsis from Brazil. Later on in 1937, P. slomei was described by Southwell and Krishner from batrachian (Toad) in South Africa. Johnston and Mawson (1940) reported another species. P. murreyensis from a fish of Australia. From Japan, Yamaguti (1941) described P. lonis in a fish. In 1946 another species was described by Annereaux and also gave a comprehensive key of all the known species of the genus.

Kung in 1948 added another species P. brevis to this genus from a batrachian host of Africa. The six species, of which five were new, P. heteropneustus, P. clarius, P. singhi, P. hyderabadensis, P. viviparus and procammallanus sp. were described by Ali (1954) from fishes in Hyderabad (India). Thus, there are altogether 30 species of the genus described so far, majority of which are reported from fishes, while only three species are described from batrachians (Toad) host.

On the basis of differences in the characters of the spicules Ali (1957) divided this genus into three subgenera, Procamallanus, Monospiculus and Isospiculus and included P. parasituri Fujita, 1927, and P. slomei Southwell et Krshner, 1937, in Monospiculus and P. mehrii Agrawal, 1930, P. planoratus Kulkarni 1935, P. wright Pereira, 1935, P. cearnsis (Sie) Pereira, 1935, P. inopinatus Tav., 1928 and P. xenopodis Baylis, 1929, in Isospiculus and 15 known and 5 new species in Procamallanus with a key to species of each subgenus, but made no type designation for each of his new subgenera Monospiculus and Isospiculus.

Procamallanus chauhanensis s. sp.

(Plate 1 Fig.1,2; Plate 2 Fig.3,4; Plate 3 Fig. 5,6,7)

The present worm is a common parasite of the siluroid fish Mystus seenghala in Vindhya region. It was obtained from the stomach of the fishes on several occasions. They were found attached to the wall of the stomach and had to be detached carefully by means of forceps.

The fresh and living worms appears to be reddish in colour. It is a common feature to the species collected here as well as those described by previous authors. These are the thinnest worm recovered by the author sofar. The body of the worm is of almost uniform thickness with slightly attenuated extremities, the head end being truncated and the tail end pointed in both the sexes. The female is longer than the male. The length of body varies from 3.05 - 3.15 mm. in male and 5.58 - 6.02 mm. in the female. These worms are very thin, their width not exceeding 0.076 in male and 0.125 mm. in the female. The cuticle is delicate, thin and finally transversely striated. The striations are 4-5 apart in the middle region of the body.

The excretory pore is very prominent and open on the ventral surface. It is situated at a distance of 0.22 mm. from the anterior end in the male and 0.26 mm. in the female. It leads into a prominent posterirly directed excretory duct.

The nerve ring surrounds the oesophagus near its anterior end. It is located at 0.067 - 0.069 mm. from the head end in male and 0.14 - 0.145 mm. in the female.

The number and position of the cephalic papillae is the same as found in other species of the genus. A pair of head with a laterally situated amphid between them. The mouth opens into buccal capsule which is roughly cylindrical, serves to distinguished the species. Its walls are thickest at the base and gradually decrease in thickness towards the apex. The buccal capsule measures 0.05 - 0.06 mm. in length and 0.025 - 0.03 mm. in width in the male and 0.074 - 0.076 in length and 0.039 - 0.04 mm. in width in the female.

The buccal capsule leads into the oesophagus which is composed of two portions an anterior short muscular and a posterior long glandular part. It measures 0.24 - 0.31 mm. and 0.35 - 0.42 mm. respectively in length in the male and 0.27 - 0.37 mm. and 0.37 - 0.40 mm. in female. The total length of the oesophagus is 0.60 - 0.74 mm. in male and 0.64 - 0.78 mm. in the female which forms 1/5th and 1/9th the body length in the two sexes respectively.

MALE CHARACTERS

(Plate 2 Fig.4, Plate 3 Fig.6,7)

The males are much smaller than the females. The tail is evenly tapering from the caudal extremity. The distance between the tip of the tail and cloacal opening is 0.068 - 0.070 mm. The tail is provided with caudal alae which are fairly well developed measuring 0.30 - 0.33 mm. in length. There are ten pairs of costiform caudal papillae, six pairs being preanal and four pairs postanal in position.

A pair of cuticular processes characteristic of the genus is present immediately behind the third pair of postanal papillae. The pair of postanal papillae lies isolated near the tip of the tail.

The testis lies in the anterior one third of the body and it extends almost to the base of the muscular portion of the oesophagus, where it reflexes to end in the posteriorly directed tip. At about the middle of the body, it leads into the vasdeferens of the same width. This is followed by the seminal vesicle which narrows to form short ejaculatory duct, opening into the cloaca.

The spicules are quite unequal and dissimilar in shape. It is noteworthy that they are heavily chitinized as compared with those of the previously described worms. The left spicules is 0.19 - 0.21 mm. and the right 0.43 - 0.50 mm. in length. The length of the two spicules are in the ratio of 3:1 the shorter being the left. The left spicules attains its maximum thickness in the middle and has a hook like tip and a broad anterior end. The large right spicule is of almost uniform diameter with finely pointed tip and a slightly expanded head.

FEMALE CHARACTERS

(Plate 1 Fig.2, Plate 2 Fig.3, Plate 3 Fig.5)

The females are thicker and twice longer than the males. The tail is short and bluntly pointed, measuring 0.037 mm. in length. It is about 1/160th of the body length.

The single filiform ovary approaches the posterior end of the oesophagus where it recurves to join the oviduct which leads into a seminal receptacle. The uterus runs posteriorly to open into the vagina, which is also connected with the blind, sac like opposite limb of the uterus.

The vagina is comparatively long about 2.83 - 3.2 mm. and runs in the straight line to open at the vulva. The vulva is quite prominent due to the presence of well developed lips. The worm liberates active motile larvae into the water.

HOST	:	*Mystus seenghala*
LOCATION	:	Stomach
LOCALITY	:	Lalpa Talab, Rewa

DISCUSSION

The worm is closely resembles to *Procamallanus fulvidraconis* Li, 1935 and *P. singhi* described previously, but differs markedly from the both of them in the size and proportion of the spicules. In *P. fulvidraconis* the spicules are extremely unequal while their length ratio in *P. singhi* is 5:1 and in the present new worm the ratio is 3:1.

The number of caudal papillae also varies in *P. singhi* and *P. chauhanensis*, there being eleven in the former and ten in the latter. The caudal alae are relatively shorter in *P. chauhanensis* than those present in *P. singhi*.

In *P. singhi* the tail of the female terminates in two short processes while in the new species under discussion its end in a bluntly rounded tip devoid of processes. The two worms also differ markedly in body measurements. Hence, the author, feels justified to erect a new species for the worm described there.

It is therefore, concluded that the species described here is a new to science. It is proposed to name it as *P. chauhanensis* after honourable Prof. B.S. Chauhan former Director, Zoological Survey of India and Vice-Chancellor Saugar University and eminent helminthologist of India.

Professor W. A. Nizami
Collection

PLATE 1

Explanation of figures

Procamallanus chauhanensis n. sp.

Fig. 1 End on view of head.

Fig. 2 Tail region of female.
Lateral view.

PLATE 1

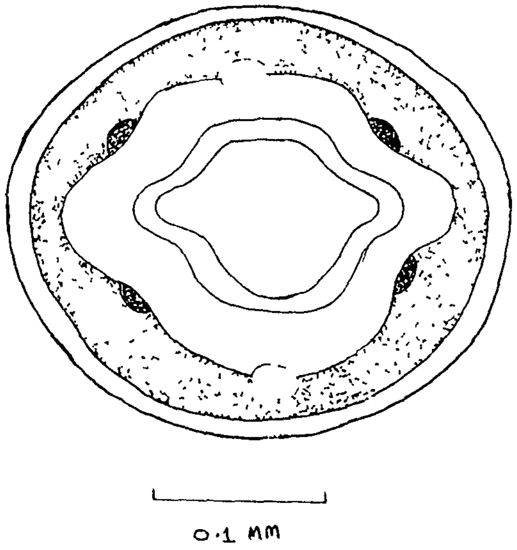

FIG. - 1

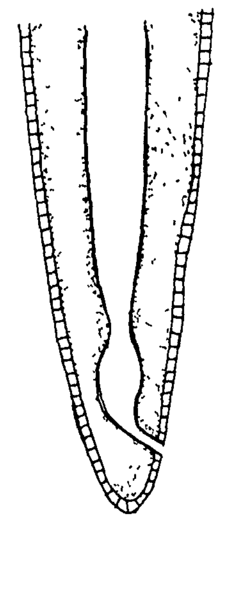

FIG. - 2

PLATE 2

Explanation of figures

Procamallanus chauhanensis n. sp.

Fig. 3 Anterior region of female.
Lateral view.

Fig. 4 Head end of male.
Lateral view.

PLATE 2

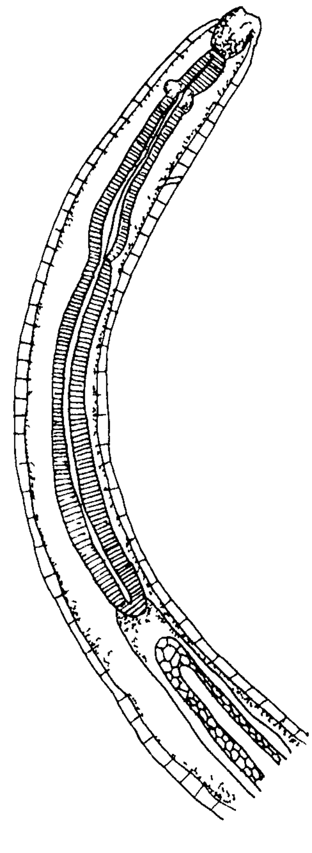

FIG. - 3

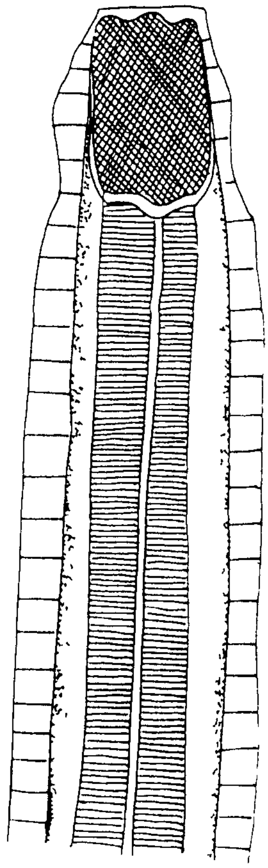

FIG. - 4

PLATE 3

Explanation of figures

Procamallanus chauhanensis n. sp.

Fig. 5 Vulvar region of female. Showing vulva, vagina and uterus.

Fig. 6 Tail region of male. Ventral view.

Fig. 7 Spicules ventral view.

PLATE 3

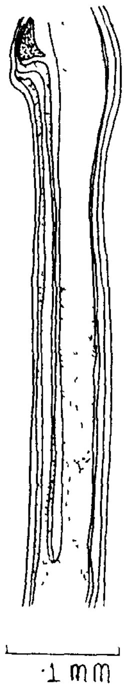

FIG. - 5

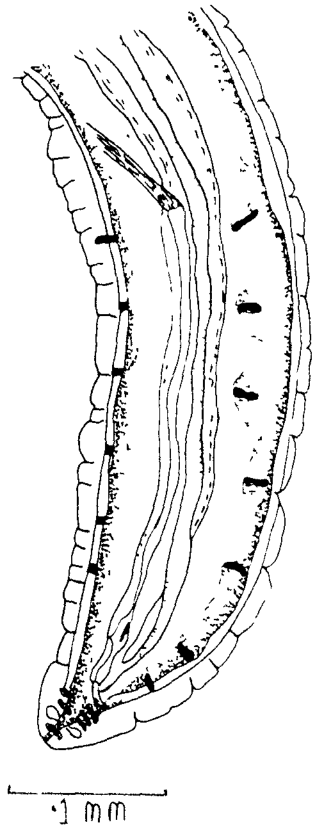

FIG. - 6

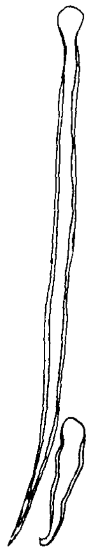

FIG. - 7

CHAPTER V

Camallanus thaparansis n.sp.

CAMALLANUS Railliet et Henry 1915

The genus Camallanus was created by Railliet et Henry, 1915 for the species *C. undulatus* having buccal capsule of two lateral valves, without chitinous buccal cavity behind the valve of trident shape. Later on about twenty new species from Amphibia and thirteen species from Reptilian hosts added to this genus by various workers from different part of world. In India in 1922 first Baylis et Daubney obtained a new species *C. kachugae* from *Kachuga smithii* in Punjab. Karve (1930) reported another new species of *C. baylisi* in *Rana tigrina*. Moorthy (1937) recorded a new species *C. sweeti* from different fishes host such as *ophiocephalus gachua*, *Lepidocephalichthys tharmalis*, *Barbus* and *Gombusia* from south India.

Chakravorty (1939) redescribed *C. anabantis* in number of fishes such as *O. punctalis*, *Rasbora doniconius* etc. *C. salmonae* was added by Chakravorty in 1942 from the host *Salmo* sp. in Kashmir. Khera (1954) reported three new species of genus camallanus from different hosts. He obtained *C. unispiculus* from the intestine of the fish *Mastacembelus armatus* (Lacep); *C. atridentus* from *ophiocephalus punctatus* (Bloch) and *C. ranae* from the intestine of frog *Rana cynophylectis*.

At present the member of this genus were obtained from fishes, Amphibian and Reptilian hosts. The described fishes species are as : *C. melanocephalus* (Rud, 1819); *C. papillifer* (Molin, 1858); *C.tridentatus* (Drasche, 1884); *C. truncatus* (Rud, 1914); Syn of *C. lacustris* (Zoega); Yorke and Maplestone (1926); *C. ancylodirus*, ward et Magath, 1917; *C. oxycephalus* Ward et Magath, 1917; *C. cotti* Fujita, 1927; *C. kirandensis* Baylis 1928; *C. wolgensis* Levashov, 1929; *C. anabantis* pearse, 1933; *C. ophiocephali* Pearse, 1933; *C. trichogasterae* Pearse, 1933; *C. sweeti* Moorthy, 1937; *C. zacconis* Li, 1941; *C. salmonae chakravorty*, 1942; *C. carangis* olsen, 1954; *C. hypophthalmichthys* Achmerov, 1954; *C. atridentus* Khera, 1956 and *C. unispiculus* Khera, 1956.

The described Amphibian nematodes of the genus *Camallanus* are as *C. nigrescens* V. Linstow 1906; *C. baylisi* Karve, 1930; *C. multiruga* Walton, 1932; *C. pipientis* Walton, 1935; *C. Kaapstaadi* Southwell et Kirshner, 1937; *C. mazabukae* Kung, 1948; *C. multilineatus* Kung, 1948; and *C.* ranae Khera, 1956.

Nematodes of Reptilian host has been recorded as *C. microcephalus* (Dugardin, 1845) Syn. *C. Confusus* Railliet et Henry, 1915, *C. cyathocephalus*, *C.*

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chelydrae, *C. elegans*, *C. floridianae*, *C. troosti*, *C. testudinis* of MacCallum; *C. seurati* Magath, *C. americanus* Magath; *C. trispinosus* (Leidy 1851); *C. undulatus* Railliet et Henry, 1915; *C. ptychozoondis* MacCallum, 1918; *C. scabrae* MacCallum, 1918, Syn. *C. floridianae*, *C. elegans*, *C. chelydrae*, *C. troosti* and *C. cyathocephalus* MacCallum; *C. americanus* Magath, 1919, Syn. of *C. trispinosus* Walton (1927), *C. kachugae* Baylis et Daubney, 1922; *C. intermedius* Hsu et Hocppli, 1931; *C. magati* Sprehn, 1932; *C. octorugatus* Baylis, 1933; *C. magnorugosus* Caballero, 1939; *C. parvus* Caballero, 1939; and *C. amazonicus* Ribeiro, 1941. Syn. of *C. trispinosus* (Leidy, 1851).

Camallanus thaparansis n. sp.

(Plate 4 Fig.8,9; Plate 5 Fig.10,11)

The present new species is represented by fifteen specimens, ten females and five males, recovered from the intestine of the frog, *Rana cynophlectis* at Chakghat Rewa.

The worms are short medium size and slender. The cuticle is delicate, thin and finaly striated. The mouth is surrounded by six papillae, two of them lateral and four sub medium in position. The buccal capsule is formed by two buccal valves. These buccal valves are broader than long. They are more broad anteriorly than posterior. The buccal valves measures 0.126 mm. in length and 0.169 - 0.18 in maximum breadth in female and 0.091 mm. in length and 0.12 - 0.13 mm. in maximum breadth in the male worms, excluding the posterior ring.

The buccal valves are strongly chitinized with 9-12 ridges on each side. There are 12 chitinous ridges in females where as 9-12 in male worms. Occasionally a small chitinized tooth like projection is present between two of the longitudinal ridges. The buccal capsule is separated from the oesophagus by a chitinous ring, followed by a small cavity which is also lined with chitinous ring. The chitinous ring has a diameter of 0.10 - 0.15 mm. in female and 0.079 - 0.86 mm. in male worms.

The trident is well developed except for its middle prong which is very small, being hardly visible. The middle prong of the trident measures 0.02 - 0.023 mm. in length in female and 0.012 mm. in males whereas the lateral prongs are 0.055 - 0.065 mm. in female and 0.05 - 0.06 mm. in male worms.

The oesophagus is divided into two portions the anterior, club shaped, muscular portion and the posterior, cylindrical, glandular portion. The anterior portion of the oesophagus, however, is longer than the posterior portion. The anterior portion of oesophagus measures 0.69 - 0.74 mm. in length in female and 0.44 - 0.48 mm. in male. The posterior portion of the oesophagus is 0.58 - 0.62 mm. in length in female and 0.34 - 0.38 mm. in male nematodes.

There are three prominent, oesophageo-intestinal valves separate the posterior portion of the oesophagus from the intestine. The intestine is as broad as the posterior portion of the oesophagus. The lumen of the intestine is wider than the oesophagus. The cells of the intestinal wall can not be clearly distinguished. The intestine leads into a very short and narrow rectum, measuring 0.076 mm. in length in female. The rectum opens directly to the exterior at the anus in female. In male worms, the rectum opens into a cloaca which also receives the genital duct. The three rectal gland cells present at the junction of the intestine and the rectum.

The nerve ring surrounds the anterior portion of the oesophagus at its narrowest region. It is situated at the distance of 0.24 - 0.26 mm. from the anterior end in female and 0.18 - 0.19 mm. in male worms.

The lateral cervical papillae are minute, fine and pointed. They are situated in the region of the anterior portion of the oesophagus at the distance of 0.29 mm. from the anterior end in female and 0.26 mm. in male worms.

FEMALE CHARACTERS

(Plate 4 Fig.9; Plate 5 Fig.10)

The female worms are medium in size and moderately broads. They measures 24 - 25.9 mm. in length and 0.54 - 0.58 mm. in diameter. The worms are blunt at both ends. The diameter of the head at its anterior angles is 0.107 - 0.125 mm. The tail is short finger shaped although its tip is bluntly pointed and slightly bifid at tip. It measures 0.18 - 0.2 mm. in length.

The vulva is pre-equatorial. In the specimen measuring 25 mm. in length. It is situated at the distance of 9.58 mm. from the anterior end. The vulvar opening is an oval slit like opening situated at the mid ventral side of the worm. The narrow muscular vagina runs posteriorly, measuring 1.4 - 1.5 mm. in length.

The vagina gives off two distended uterine tubes on opposite side. The coils of posterior uterine tube extend 0.29 - 0.32 mm. in front of the posterior end. The posterior limb of the uterine tube ends blindly, there is no ovary. The anterior limb of uterine tube ends in single anterior ovary which is situated at the distance of 0.25 - 0.5 mm. behind the anterior end of the intestine. The embryos measuring 0.29 - 0.13 mm. in length, having a blunt anterior end and thin pointed, gradually tapering, posterior end.

MALE CHARACTERS

(Plate 4 Fig.8; Plate 5 Fig.11)

The male worms measuring 6.75 - 7 mm. in length and 0.157 - 0.185 mm. in diameter. The dorso-ventral diameter of the head at its anterior angles is 0.064 mm. The tail is short, conical and pointed. It is 0.14 mm. in length and has a bifid tip. The male has well developed, broad caudal alae, which extend for a length of 0.55 - 0.59 mm. They measure 0.13 mm. in maximum width and end just behind of the bifid tip.

There are fourteen pairs of caudal papillae, out of which seven pairs are pre-cloacal, two pairs cloacal, and five pairs post-cloacal papillae. The posterior most, fifth pair of post-cloacal papillae is sessile and isolated the fourth pair. The fourth pair of post cloacal papillae is also isolated but pedunculated. The remaining three anterior pedunculated post-cloacal papillae are close together in a group. The two cloacal pairs of papillae are small and pedunculated. Except for the posterior two pairs of pre-cloacal papillae which are close together and near the cloaca, the pre-cloacal papillae are isolated and distributed at regular intervals. The pre-cloacal papillae have knob-like terminations. All the caudal papillae are ventro-lateral except the two cloacal pairs which are lateral in position.

There are two unequal, feably and imperfectly chitinized spicules. The right spicules is longer than the left and stout. It measures 0.455 mm. in length. It is alate throughout its length. The distal top of the spicule is simple there is no lateral barb or prong. The left spicule is poorly chitinized and less stout than the right spicule. It is slender and measures 0.33 - 0.36 mm. in length. A single testis is situated near the anterior end of intestine.

Host : *Rana cynophlectis*

Location : Intestine

Locality : Chakghat, Rewa.

DISCUSSION

Walter (1935) formulated the characters of the five species the genus Camallanus obtained from the Amphibian host and pointed out their differences from one another. The five species are : *C. microcephalus* (Dujardin, 1845) Railliet et Henry, 1915; *C. nigrescens* (V. Linstow, 1845) Railliet et Henry, 1915; *C. baylisi* Karve, 1930; *C. multiruga* Walton, 1932 and *C. pipientis* Walton, 1935. Southwell and Krishner (1937) recorded another species, *C. kaapstaadi*, from the Clawed toad, *Xenopus laevis* in South Africa. Subsequently Kung (1948) added two more species, *C. mazabakae* and *C. multilincatus* from bull frogs in South Africa and *R. catesbiana* from North America respectively.

The new species is closely resemble to *C. baylisi*. However, it differs from *C. baylisi* in size of the body and dimensions of the various structures; in possessing a bifid female tail; in having narrower caudal alae; in the number of post-caudal papillae; in size and chitinized condition of the left spicules and in the absence of prongs or barbs on the spicule.

In view of the characters exhibited, the worm obtained from frog Rana cynophylectis and described above is considered to be a new species. It is proposed to name as Camallanus thaparansis after the name of Professor G.S. Thapar.

PLATE 4

Explanation of figures

Camallanus thaparansis n. sp.

Fig. 8 Anterior region of male.

Fig. 9 Vulvar region of female.

PLATE 4

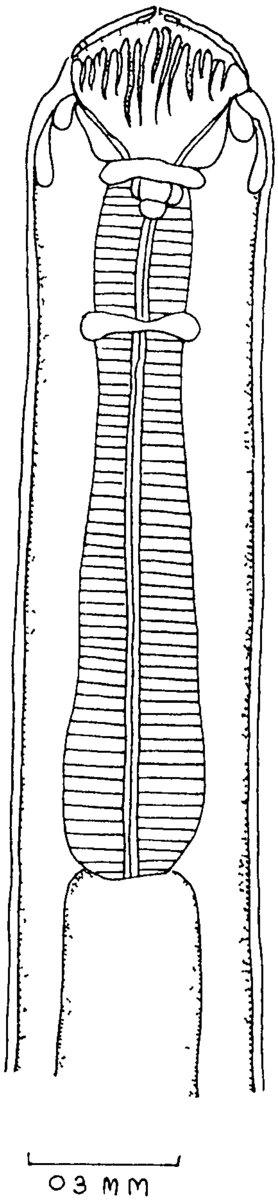

FIG. - 8

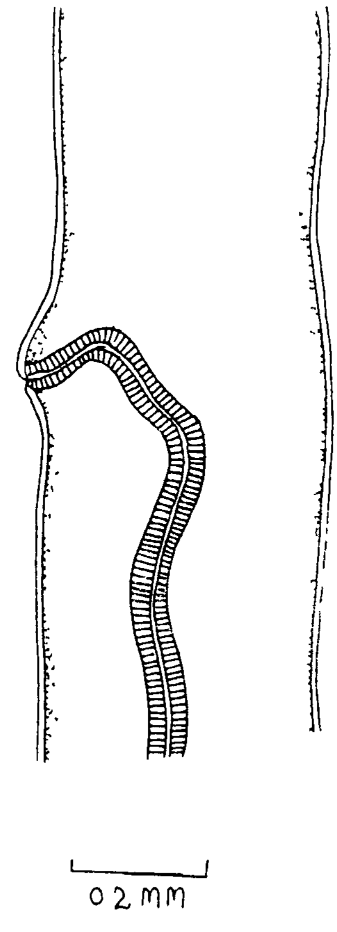

FIG. - 9

PLATE 5

Explanation of figures

Camallanus thaparansis n. sp.

Fig. 10 Tail region of female.

Fig. 11 Tail region of male.

PLATE 5

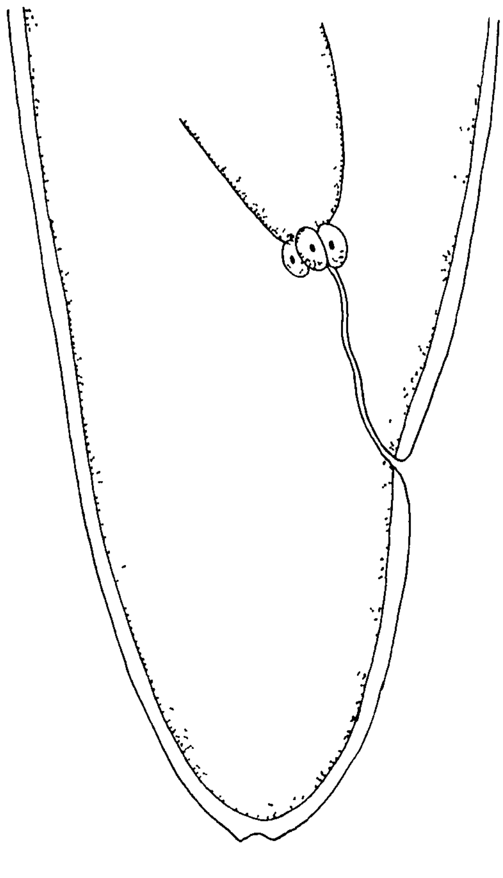

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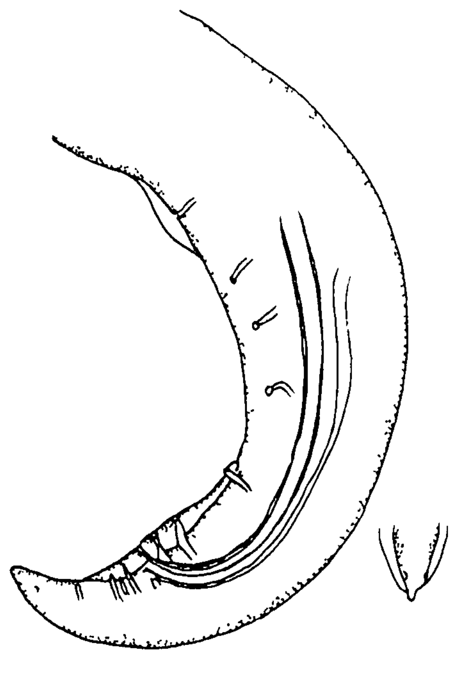
FIG. - 10



0·1 mm

FIG. - 11

CHAPTER VI

Ophidarcaris ajgaris Khera, 1956

<u>OPHIDASCARIS</u> Baylis, 1921

The genus <u>Ophidascaris</u> was created by Baylis 1921 for <u>O. filaria</u> (Dujardin, 1845) as genotype, synonymous <u>Ascaris rubicunda</u> Schneider, 1866; <u>Ascaris infundibulicola</u> Linst, 1903. Later on <u>O</u>. <u>obconica</u> (Baird, 1860) in <u>Helicops angulatus</u> from Brazil; <u>O</u>. <u>radiosa</u> (Schneider, 1866) in <u>Bitis gabonica</u>, <u>Causus rhombeatus</u> from Africa; <u>O. gestri</u> (Parona, 1890) in <u>Tropidonotus guincunciatus</u> from India, Burma; <u>O. papillifera</u> (Linstow, 1898) in snake; <u>O</u>. <u>solitaria</u> (Linst, 1903) in <u>Diplosadomorphus dendrophilus</u> from Sian; <u>O. najae</u> (Gedoelst, 1916) in <u>Naja</u> and <u>Bungarus</u> sp. from Africa, India; <u>O</u>. <u>intorta</u> (Gedoelst, 1916) in <u>Bitis</u> sp. <u>Naja nivea</u> from Africa, were included in this genus.

Baylis, 1921 described <u>O</u>. <u>mombasica</u> in <u>psammophis</u>, <u>Ablabophis</u>, <u>Crataphopeltis</u> from Africa. <u>O</u>. <u>labiatopapillosa</u> was added by Walton, 1927 which he obtained in <u>Coluber constrictor</u>, <u>Natrix natrix</u>, <u>N</u>. <u>sipedon</u> from Florida. He also recovered its larval from in <u>Amphiuma tridactylum</u>, <u>Rana aesopus</u>, <u>R</u>. <u>catesbiana</u> and <u>R</u>. <u>stenocephala</u>. The life cycle was studied and described by Walton in 1937.

Sprehn in 1929 added a new species _O. arndti_ in _Lachesis lanceolatus_ from South America. Its male and female specimen was redescribed by Freitas (1955), procured from _Xenodon merimii_ in Brazil. Robinson 1934 describe a new species _O.baylisi_ in _Python reticulatus_ from Malaya. Yamaguti 1935 recorded _O.natricis_ from the hosts _Natris tigrina_ and _Elaphe quadrivirgata_ in Japan. It is also recovered from another host aquatic snake by Bagdanov (1954) in Russia. The species _O.trichuriformis_ Vaz, 1935 reported in various hosts; _Liophis miliaris_, _Crotalus terrificus_, _Xenodon meroremi_ and _Lgstrophis dorbyangi_ in Brazil.

Schuurmans stekhoven, 1937 described _O. amucronata_ in _Python sebae_ and _Bitis arietans_ from Africa. Kreis, 1938 reported two new species _O.genoheteromegala_ and _O.microspicula_ from two different hosts, _Coluber quatuorlineatus_ and _Naja tripudians_ respectively in Tropical Asia. _O.travassosi_ was added by Vaz. 1938 from _Crotalus terrificus_ in Brazil. In Mexico, Caballero, 1939 described _O.ochoterenai_ in _Drymarchon corais melanurus_.

In Australia Johnston et Mawson, 1942 recorded _O.pyrrhus_ in various host as _pseudechis porphyriacus_, _Demansia psamnophis_ and _Notechis acutatus_. In 1947 Johston et Mawson described _O.varani_ from *Varanus various* in Queenland. Schuurmans Stekhoven 1950 obtained *O.crassilabiata* in *Notipsar cinereus*. *O.sicki* was described by Freitas in 1951 in two hosts, *Xenodon merrimii* and *X. severus* from Brazil. Khera, 1956 added a new species *O.ajgaris* from the host *python molurus* in India.

Ophidascaris ajgaris Khera, 1956

(Plate 6 Fig.12, 13   Plate 7 Fig.14, 15)

Eleven specimens including six females and five males, were recovered from the body cavity of *Python molurus*, which died in the Govt. Model Science College, Rewa campus.

The worms are large and stout, with a thick straiated cuticle. The circular striations of the cuticle are fine and about 0.0.004 - 0.007 mm. apart from each other. The most prominent generic character, the cervical alae are absent.

The body of the worm is elongated and a little more tapering in front than the behind. The terminal mouth opening is a dorso - ventral slit like, surrounded by three, almost square lips. Each lip bears two papillae. All the three lips have a slightly emarginate anterior border and rounded free angles. The dorsal lip is large and have double terminations, while each ventro-lateral lip has a large papillae towards the ventral and a small papilla towards the lateral margin.

A dentigerous ridge, consisting of minute regular teeth, extends upto the angles of each lip. The pulp of each lip has two lobes. The free end of each lobe being multiradiate. There are no prolongation towards the middle of lips or towards the margin. The inter - labia are short and bluntly conical. There are well developed grooves at the bases of the lips.

The mouth followed by elongated muscular oesophagus measuring about 5.3 - 7.00 mm. in length in female and about 4.52 - 6.56 mm. in male. The oesophagus is not clearly distinguished into regions but it is slightly broadest anteriorly than its posterior end. The oesophageal bulb is absent. There are three large oesophageo intestinal valves are located at the posterior end of the oesophagus.

The intestine is very broad, with thick muscular walls and a moderatly wide lumen. The intestine leads in to a cloaca which also receives the opening of genital duct in male, and in female into rectum which opens to the exterior. The rectum is about 0.32 mm. long in female. The junction of the intestine and rectum is marked by the presence of the three rectal gland cells.

The nerve ring surrounds the oesophagus at the distance of 1.22 - 2.33mm. from the anterior end in the female and 1.45 - 2.54 mm. in male worms.

The excretory pore is a small round opening, mid ventral in position. It is situated nearly close to the nerve ring about the distance of 1.32 - 2.43 mm. from the anterior end in female and 1.54 - 2.61 mm. in male worms.

FEMALE CHARACTERS

(Plate 6 Fig.12, 13 Plate 7 Fig.15)

The female worm is larger in size than the male measuring 119-154 mm. in length and 1.5 - 2.2 mm. in diameter. The "head" measures 0.3 - 0.5 mm. in diameter. The tail is bluntly conical measuring 0.4 - 0.54 mm. in length. The vulva is quite prominent due to the presence of well developed surrounding lips. It is situated post equatorial. In the specimen measuring 119 mm. in length, it is situated at a distance of 46 mm. from the posterior end, dividing the body in the proportion of about 6:4.

The female gonads consists of a pair of filiform ovaries with their tips lying opposite to each other. They are connected with separate wide oviduct of each side. The two oviduct run posteriorly parallel to each other which gradually widen to form the two uterine tubes. The two uterine tubes run posteriorly parallel to each other and combined to form unpaired uterus. The unpaired portion of uterus measures 3mm in length which communicate with the vagina. The vagina is simple and muscular measuring about 0.2 - 0.22 mm. in length.

The eggs are rounded to oval in shape, with a thick transparent shell and an outer dirty white, irregular albuminous coat. The egg measures 0.078 - 0.085 x 0.74 - 0.08 mm. in size.

MALE CHARACTERS

(Plate 6 Fig.12, 13 Plate 7 Fig.14)

The males are smaller than the female worms, measuring approximately 69 - 149 mm. in length and 1.09 - 1.09 mm. in diameter. The diameter of the 'head' is 0.217 - 0.435 mm. The tail is short and bluntly rounded and measure 0.25 - 0.43 mm. in length. There are five pairs of post cloacal papillae. The most anterior pair of papillae is situated a little behind the cloaca and has double terminations. Three pairs of post cloacal papillae are ventral in position and form a short of triangle. The remaining two postcloacal pairs are lateral to sub-dorsal in position. There are forty to forty five pairs of pre-cloacal papillae. The latter are situated in two or three rows.

The testis is filiform extending up to the neighbourhood of oesophagus where it is recurved to run in the posterior direction with its tip lying at about the middle of the body.

The spicules are very long, cylindrical slightly tapering towards the free end, equal and alate. They are measureing 5.3 - 6.3 mm. in length with bluntly conical tips. The width of the spicules including the sharft and alae is 0.065 - 0.07 mm.

Host : *Python molurus*

Location : Body cavity

Locality : Govt.Model Science College, Rewa campus.

DISCUSSION

Twenty-four species of genus *ophidascaris* have been described all over the world so far : *O.filaria* (Dujardin, 1845); *O.obconica* (Baird, 1860);

O.radiosa (Schneider, 1866); *O.gestri* (Parona, 1890); *O.papillifera* (Linstow, 1898); *O.salitaria* (Linstow, 1903); *O.intorta* (Gedoelst, 1916); *O.najae* (Gedoelst, 1916); *O.mombasica* Baylis 1921; *O.labiatopapillosa* Walton, 1927; *O.arndti* Sprehn, 1929; *O.excavata* Hsue and Hoeppli, 1931; *O.baylisi* Robinson, 1934; *O.trichuriformis* Vaz. 1935; *O.natricis* Yamaguti, 1935; *O.amucronata* Schuurmans Stekhoven, 1937; *O.microspicula* Kries, 1938; *O.genoheteromegala* Kries, 1938; *O.travassosi*; Vaz 1938; *O.ochotenenai* Caballero, 1939; *O.pyrrhus* Johnston and Mawson, 1942; *O.varami* Johnston and Mawson, 1947; *O.sicki* Texeira de Freitas, 1951 and *O.ajgaris* Khera, 1956.

This species is characterized in possessing the longest pair of spicules (5.3 - 6.3 mm long) described sofar in the genus.

The description of three species of ophidascaris based female worms only, one of which, in *O.intorta*, the vulva is situated in the anterior third of the body. The species *O.solitaria* is inadequately described. The present species differs from *O.solitaria* in the general size, shape of lips, extension of dentigerous ridge and the size of the oesophagus. This species also differs from *O.labiatopapillosa* in the general size, shape of the lips, size of the oesophagus and the tail, position of vulva and size of the eggs.

This species differs from the O.obconica, O.orndti, O.baylisi, O.natricis, O.miscrospicula, O.genoheteromegala, O.travassosi, O.ochoterenai, O.varani and O.sicki in the size of the spicules which are double or more than double in the length of spicules of these species.

The size and shape of spicules has not been described in O.radiosa, O.gestri and O.amucronata. The new worm, however, differs from O.radiosa and O.amucronata in the position of vulva and the number of caudal papillae. It further, differs from O.radiosa in the presence of dentigerous ridge and size of the tail. This species differs from O.gestri in the position of vulva which is post equatorial and in the number of caudal papillae.

The present species differs from O.excavata in general size of body and size of the various organs and śtructure, in shape of lips, in the extension of basal grooves, in position of vulva, number of pre-cloacal papillae and size of spicules.

The worms differs from O.filoria and O.najae in the shape of the free end of the pulp of the lips, in the extension of the dentigerous ridge, in the position of vulva, in spicules being long and equal and in number and arrangement of post cloacal papillae. It further differs from *O.filaria* in having large eggs and from *O.najae* in having long oesophagus and in number of pre-cloacal papillae.

The present species differs *O.mombasica* in the shape and size of lips, extension of dentigerous ridge, size of oesophagus, position of vulva, size of the eggs, number of pre-cloacal papillae, and size of the spicules.

From the *O.trichuriformis* this species also distinguished in the general size of the body and other organs, extension of basal grooves, size of the oesophagus and tail in the both sexes, in size of eggs, number of pre and post cloacal papillae and size and shape of spicules.

This species differs from *O.pyrrhus* in the shape of pulp, in shape of the tail, in the size and structure of spicules and the number of pre anal and post-cloacal papillae.

From *O.papillifera* this species can be distinguished in general size of body and other organs, in shape of the lips, in size of the tail in the both sexes, in the size of eggs, in the number of pre and post-cloacal papillae and in size and shape of spicules.

The present worm also differs from the *O.ajgaris* in the general size of body and in the size and shape of spicules. The author believe that these minor variations are due to environmental condition.

PLATE 6

Explanation of figures

Ophidascaris ajgaris Khera, 1956

Fig. 12 Head dorsal view.

Fig. 13 Head end-on view.

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PLATE 6

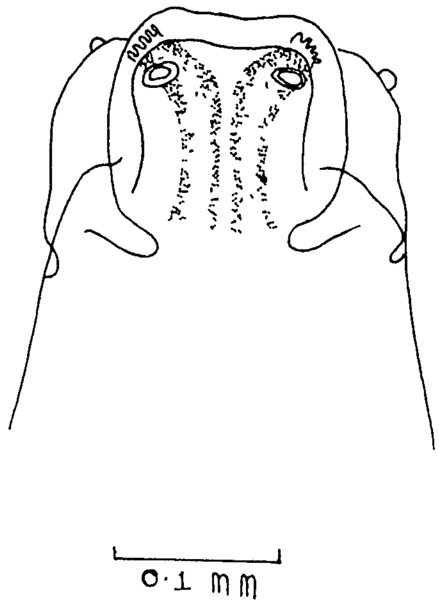


FIG. - 12

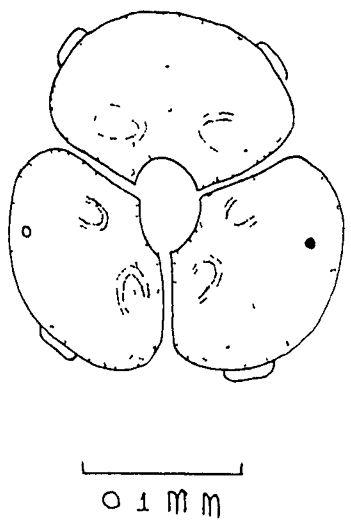


FIG. - 13

PLATE 7

Explanation of figures

Ophidascaris ajgaris Khera, 1956

Fig. 14 Tail region of male

Fig. 15 Eggs.

PLATE 7

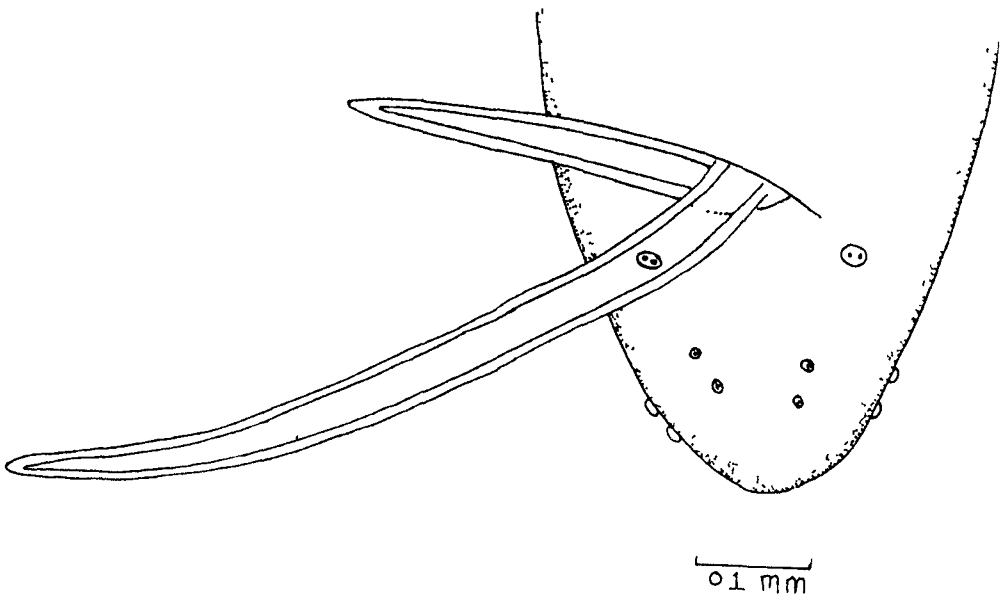


FIG. - 14

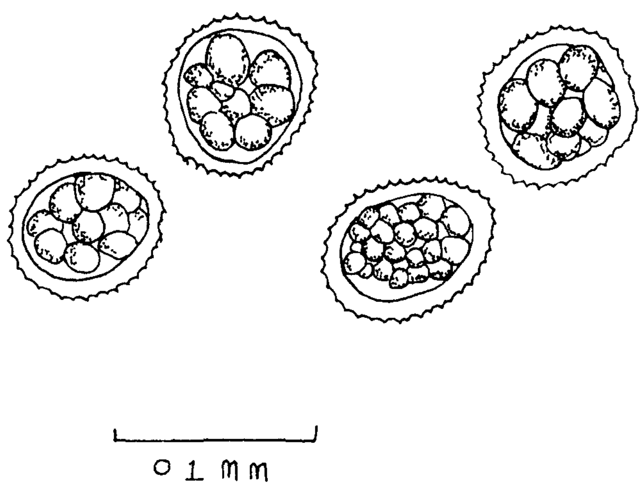


FIG. - 15

CHAPTER VII

Oxyspirura mehransis n.sp.

OXYSPIRURA Drasche in Stoss, 1897

The genus *Oxyspirura* was established by Drasche in Stossich in 1897 for *Cheilospirura cephaloptera* Diesing, 1861, previously described by Molin, 1860. Since then a large number of species have been described from different types of birds from various parts of the world such as *Oxyspirura* (O) *Cephaloptera* (Molin, 1860); *O. brevipenis* (Molin, 1860), synonyms *Spiroptera microdactylimargravil* Molin, 1860; *O. anacanthura* (Molin, 1860) Syn. *Spiroptera crotophagae* - ani Molin, 1860; *O. cephaloptera*, (Molin, 1860); *O. sigmoidea* (Molin, 1860) syn. *Spiroptera anthuris* (Rud., 1819); *O. brevisubulata* (Molin, 1860), *O. heteraclita* (Molin, 1860); *O. mansoni* (Cobb. 1879) syn. *Spiroptera emmerezii* emmerez et Megnin 1901,- Marotel et Carougeau 1902; *O. ophthalmica* (Linst., 1903); *O. siamensis* (Linst., 1903); *O. parvovum* sweet, 1910 synonyms of *O. mansoni* Baylis, (1934); *O. acanthochaerae* (Johnston, 1912); *O. tanasijtchuki* Skrj, 1916.

O. americana was described by - Walton, 1927, *O. popowi* Skrj, 1919; *O. Schulzi* Skrj, 1929; *O. podjapolskoj* Skrj, 1929; *O. elani* sandground, 1930; *O. baskakowi* Skrjabin, 1932; *O. Crami* (Khalil 1930); *O. Kaitingensis* Hsii, 1933; *O. peipingensis* Hsii, 1933; *O. myzomelae* Baylis, 1935; *O. Tsingchengensis* Hsii, 1935;

O. havali, Caballero, 1936; O. toroi Caballero, 1937; O. witteri Schuurmans - Stekhoven, 1937; O. crassa Caballero, 1938, O. Streperae, Johnston et Mawson, 1941; O. bancrofti Johnston et Mawson, 1941, O. octopapillata Caballero, 1942, O. buccosulcata singh, 1948; O. indica Singh, 1948; O. Brevisubulata var. ibisi Vuylsteke, 1953; O. dendropicos vuylsteke, 1953; O. cameroni strachan, 1957; O. hispanica Yeh, 1957, and O. pusillae Wehr et Hwang, 1957.

There has been a difference of opinion about the validity of the various subgenera of the genus Oxyspirura. Skrjabin (1931) divided this genus into three subgenera i.e. cramispirura, oxyspirura and Yorkespirura on the basis of the divided buccal cavity by constriction (Yorkespirura) and undivided buccal cavity (Oxyspirura and Cramispirura) and also on equal/subequal spicules (Cramispirura) and unequal spicules (Oxyspirura).

Baylis (1934) placed O. parvovum Sweet 1910, as a synonym of O. mansoni (Cobb, 1879).

Cram (1937) reviewed the genus Oxyspirura and included under the subgenus Yorkispirura only three species viz. O. (Y). tanasijtchuki (Skrjabin, 1960); O. (Y). tsingchengensis (Hsii, 1935); O. (Y). mansoni

(Cobbold, 1879) Ransom, 1904.

Skrjabin, Shikhobalova and Soboleva (1949) while re-examining the original specimens, included O. crassa Caballero, 1938 under the subgenus Yorkeispirura.

Wehr and Hwand (1957) removed O. Crassa from the sub-genus Yorkeispirura, on the basis of buccal capsule was not divided into parts by a constiction and the spicules were subequal and of similar in structure. Another species of the subgenus Yorkeispirura, O. (Y). Octopapillata was described by caballero, 1942 in Polyborus cheriways. Wehr et Hwang (1957) described O. (Y). pusillae from the orbital cavity of the Brown headed Nuthatch Sitta pusilla pusilla (Latham, 1790) from Georgia, U.S.A.

Yet (1957) expressed doubt about the validity of the three subgenera of Oxyspirura viz. cramispirura Skrjabin, 1931; Oxyspirura (Drasche in Stoss, 1897) Skrjabin, 1931 and Yorkespirura Skrjabin, 1931. Skrjabin 1931 proposed the division of this genera on the shape of buccal capsule and relative length of the spicules. He considered that the shape of the buccal capsule is unsuitable for use in the division of the genus into subgenera, as the buccal capsule takes diverse transitional shape. In the single specimen of genotype, the buccal capsule has a slight constriction and is intermediate in shape between the divided and undivided types.

In _O. indica_ Singh, 1948 the buccal capsule is stated to be cylindrical, in _O. myzomelae_ Baylis, 1935 it is subcylindrical, in _O. peipingensis_ Hsii 1953 it has a prominent bulge on its middle portion and in _O. mansoni_ it is divided into two parts. Some of the _Oxyspirura_ species were seen to have an oval buccal capsule, from the surface view. In the lateral view it is very wide and in the ventral view it seems to be very narrow.

Ali (1960) described seven new species of the genus _Oxyspirura_ from the birds in Hyderabad. Here he followed the classification as proposed by Skrjabin in 1931. He pointed out that the species of the genus _Oxyspirura_ is very host specific, usually each host species has its own species of nematodes.

Barus (1963) fruther subdivided the subgenera _Oxyspirura_ and _Yorkeispirura_ and added to more subgenera _Skrjabinispirura_ and _Caballeroispirura_. He included those species of Oxyspirura which do not posses cephalic alae and may or may not have a gubernaculum under Skrjabinispirura. In Caballeroispirura, he placed those species of Yorkeispirura which have cephalic alae and a gubernaculum.

Siddiqi and Jairajpuri (1964) did not considered the presence or absence of cephalic alae and gubernaculum as characteristic of subgeneric status. Therefore considered Skrjabinispirura and Caballeroispirura as synonyms of Oxyspirura and Yorkeispirura respectively. The new species described by Barus (1963) as Oxyspirura (Skrjabinispirura) rysavyi know as O. (O) rysovyi (Barus) n. comb.

Rodrigues and Freitas (1964) examined various specimens of the type species Oxyspirura cephaloptera (Molin, 1860) Stossich, 1887 and found that the buccal capsule is distinctly divided into two parts. Therefore, they transfered all the species of the subgenus, Yorkeispirura to Oxyspirura and declaired the subgenus Yorkeispirura to Oxyspirura. Thus according to these authors the genus oxyspirura should have only two subgenera and the subgenus Oxyspirura including species which may or may not have a divided buccal capsule but having spicules markedly unequal and dissimilar;

Cramispirura including species with undevided buccal capsule and possessing equal or unequal spicules. In the same year one the above authors, Rodrigues (1964) raised Cramispirura to the rank of a genus on the basis of above characters and included in addition of the species already described under Cramispirura, four more species of Oxispirura viz. O. altensis; O. buckleyi; O. rouxi and O. prinia without giving reasons for addition.

Rodrigues (1964) also proposed a new genus Moliniospirura on the basis of a cuticular structure projecting anteriorly from the base of the buccal capsule with a species which he previously described in 1963 as Oxyspirura Cassici.

Jairajpuri and Siddiqi (1967) did not accepted Rodrigues view regarding the proposal of new genera on this characters alone of generic importance and therefore suppressed Moliniospirura. They considered that if there will be any separation in the generic or gubgeneric level, it should be on the basis of divided or undivided buccal capsule and not on a mere cuticular projection arising at the base of the buccal capsule. Further they did not paid any importance to the character or equal or subequal spicules in Cramispirura considering it to be a variable character. However, they included all species of the genus Oxyspirura described under various subgenera under the genus Oxyspirura. The author agree with the opinion of these authors that these various characters selected for the subdivision into subgenera are variable characters.

The genus Oxyspirura is very host specific and the distribution is very wide. Thirty Eight new species have been recorded from various part of India. Two of them reported by Singh (1948); nine by Ali (1960); four by Rasheed (1960); eitht by Sultana (1964); one by Siddqi and Jairajpuri (1964) and fourteen by Jairajpuri and Siddiqi (1967).

Osyspirura mehransis n. sp.

(Plate 8 Fig 16,17 Plate 9 Fig 18,19 Plate 10 Fig 20,21)

Large numbers of males and few females parasites were recovered from the intestine of a bird, Cattle Egrete, Bubulcus ibis (Linnaenus) at Housing Board Colony, Bodabag Rewa.

The worm has a slender cylindrical and spirally coiled body tapering sharply in the posterior extremity in the both sexes. The body of male and female measure 4.5 to 6.53 mm in length and 0.16 to 0.22 mm breadth. The head end in both the male and the female is rounded somewhat truncated. The head measures 0.02-0.031 mm in diameter.

The cuticle is thin and finely transversly straited, the striations are 0.005 to 0.01 mm apart from each other. The cervical alae are not observed.

The small subglobular buccal capsule divided into two parts. Entire buccal capsule measures 0.006 to 0.009 mm in length and 0.006 to 0.001 in breadth. Vestibule measure 0.016 to 0.26 mm in length and 0.006 to 0.01 mm in breadth. The oesophagus occupies one third and one fourth of the entire body length in the two sexes. It measures 1.20 to 1.56 mm in male and 1.21 to 1.85 in female. The two portion of oesophagus are not markedly distinct from one another but freebly visible in two parts, an anterior muscular oesophagus 0.46 to 0.53 in length and 0.025 to 0.045 in breadth and posterior glandular portion of oesophagus 0.85 to 0.95 mm in length and 0.05 to 0.09 mm in breadth.

The nerve ring is situated at the distance of 0.095 to 0.215 mm from the head end in the female and 0.017 to 0.216 in male.

The excretory pore open at the distance of 0.19 to 0.21 mm in both the sexes from the anterior end of the body.

The tail incurved, pointed and measure 0.28 to 0.39 in length. The caudal alae are absent. There are six pairs of small sessile caudal papillae are present on tail region. Three pairs of which preanal and three pairs are post anal in position.

MALE CHARACTERS

(Plate 8 Fig 16,17 Plate 9 Fig 18,19 Plate 10 Fig 20)

The male is smaller in size than the female and has sharply attennulated tail measuring 0.39 mm in length. It is devoid of caudal alae. The testis is situated somewhat anterior to the middle of the body extending up to the vicinity of the juction of the oesophagus and the intestine, where it recurves and ends in a posteriorly directed tip. There are six pairs of caudal papillae of which three pairs are preanal and the rest post-anals. A pair of asymmetrically situated phasmids is seen at the distance of 0.13 mm from the tip of tail.

The spicules are very unequal, dissimilar, blunt at their distal ends. Right spicules is short stout measuring about 0.138 to 0.21 mm. in length. The left spicule is long and filiform measuring 2.15 to 2.53 mm. in length. The gubernaculum is saddle shaped measuring 0.07 to 0.10 mm. in length and 0.019 to 0.028 mm. in breadth.

FEMALE CHARACTERS

(Plate 10, Fig 21)

The female is almost one and a half times as long as the male. The tail is short, sharply pointed and curved measuring 0.28 mm in length. The valva is flush with body and is situated at 0.35 mm from the tip of tail. The muscular vagina is 0.085 mm in length which is directed anteriorly. The uteri extend towards the anterior and after entering the oesophageal region, it take a backward turn to join the ovaries. The uteri are fuly packed with eggs in various stages of development. The egg measures 32 micra in length and 22 micra in breadth.

Host	:	Bubulcus ibis (Linn.)
Location	:	Intestine
Locality	:	Housing Board Colony Bodabag, Rewa.

DISCUSSION

Drasche in Stossich established the genus Oxyspirura in 1897 for Cheilospirura cephaloptera Diesing 1861, previously described by Molin in 1860, along with two more species, all as belonging to spiroptera. Since the establishment of this genus nearly Forty six species have been reported from various parts of the world. The distribution of this worm is very wide and the number of species seems to be much more than what has already been described.

Skrjabin in 1931 divided the genus Oxyspirura into three subgenera, i.e. Oxyspirura, Cramispirura and Yorkeispirura on basis of the divided buccal capsule (Yorkeispirura) and undivided buccal capsule (Oxyspirura and Cramispirura); and also on the equal spircules (Cramispirura) and unequal spicules (Oxyspirura).

The present work belong to the genus Oxyspirura Drasche in Stossich, 1897. The new species very much resemble to O. crami Khalil, 1932, O. Crassa caballero, 1938 O. pusillae Wehr & Hwang, 1957; O. hispanica Yeh, 1957, O. gubernaculata Rasheed, 1960; O. chauvancyi Diazungria, 1963; O. cisticole Sultana, 1964; O. Solitaria Jairajpuri & Siddiqi, 1967; decruri

Jairajpuri & Siddiqi, 1967 and O. acuticauda Jairajpuri & Siddiqi, 1967 in the possession of a guberculum.

The new worm differs from all the above mentioned forms except O. pusillae, O. hispanica and O. chauvancyi in having divided buccal capsule. The new forms resembles with C. pusillae in having six pairs of caudal papillae but differs from it in the relative size of spicules and in the arrangement of caudal papillae. Further the new form differs from O. hispanica in having male specimens of smaller size, in the arrangement of caudal papillae and in the relative size of spicules.

The new worm has a close resemblance to O. chauvancyi in the relative size of male specimens but however differs from it in the arrangement of caudal papillae and in the size of gubernaculum. In the new form there are three pairs of preanal and three pairs post-and papillae while in O. chauvancyi there are three pairs pre-anal, one pair adanal and two pairs of post-anal papillae. Therefore it is regarded as a new species with the name Oxyspirura mehransis n.sp.

The new species is named in honour of professor R.K. Mehra Allahabad University, Allahabad.

TABLE II

Comparative chart of *Oxyspirura* *Mehransis* n.sp. and three similar species.

Organs	*O.pusillae* Wehr & Hwang, 1957	*O.hispanica* Yeh, 1957	*O.chauvancyi* Diaz-Ungria, 1963	*O.mehransis* n.sp.
Length of ♂	6.4 mm.	16.5-18.00 mm	4.28-5.76 mm.	4.5-6.53 mm.
Buccal Capsule	divided	divided	divided	divided
Cephalic alae	absent	absent	absent	absent
Caudal alae	absent	absent	absent	absent
Caudal Papillae	6 pairs	6 pairs	6 pairs	6 pairs
Preanal papillae	4 pairs	3 pairs	3 pairs	3 pairs
Adanal papillae	----	1 pair	1 pair	----
Post anal papillae	2 pairs	2 pairs	2 pairs	3 pairs
Spicules	0.205-0.220mm 2.2-2.4 mm. I: 10.8 mm. dissimilar	0.38-0.41mm. 5.2-5.70mm. I: 13.8 dissimilar	0.175-0.20 mm 2.55-2.68 mm. I: 14 dissimilar	0.138-0.21 mm. 2.15-2.53 mm. 1: 13-1:15 dissimilar
Gubernaculum	Present	Present	Present	Present
Hosts	*Sittapusilla* *Pusilla*	*Otis tarda*	*Thamnophilus* *P. punctatus*	*Bubulcus ibis*(Linn.)

PLATE 8

Explanation of figures

Oxyspirura *mehransis* n.sp.

Fig. 16 Anterior region of male(magnifield) lateral view.

Fig. 17 Anterior region of male lateral view.

PLATE 8

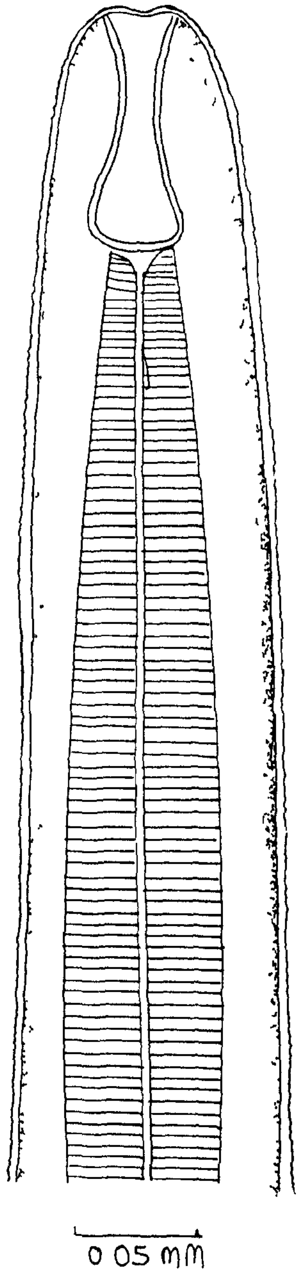


FIG - 16

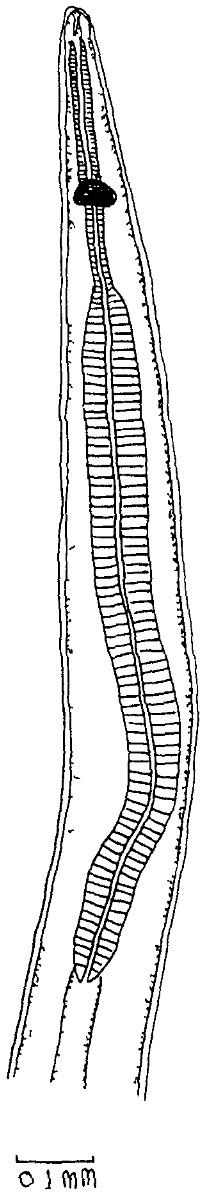


FIG - 17

PLATE 9

Explanation of figures

Oxyspirura mehransis n.sp.

Fig. 18 Posterior region of male lateral view.

Fig. 19 Posterior region of male lateral view.

PLATE 9

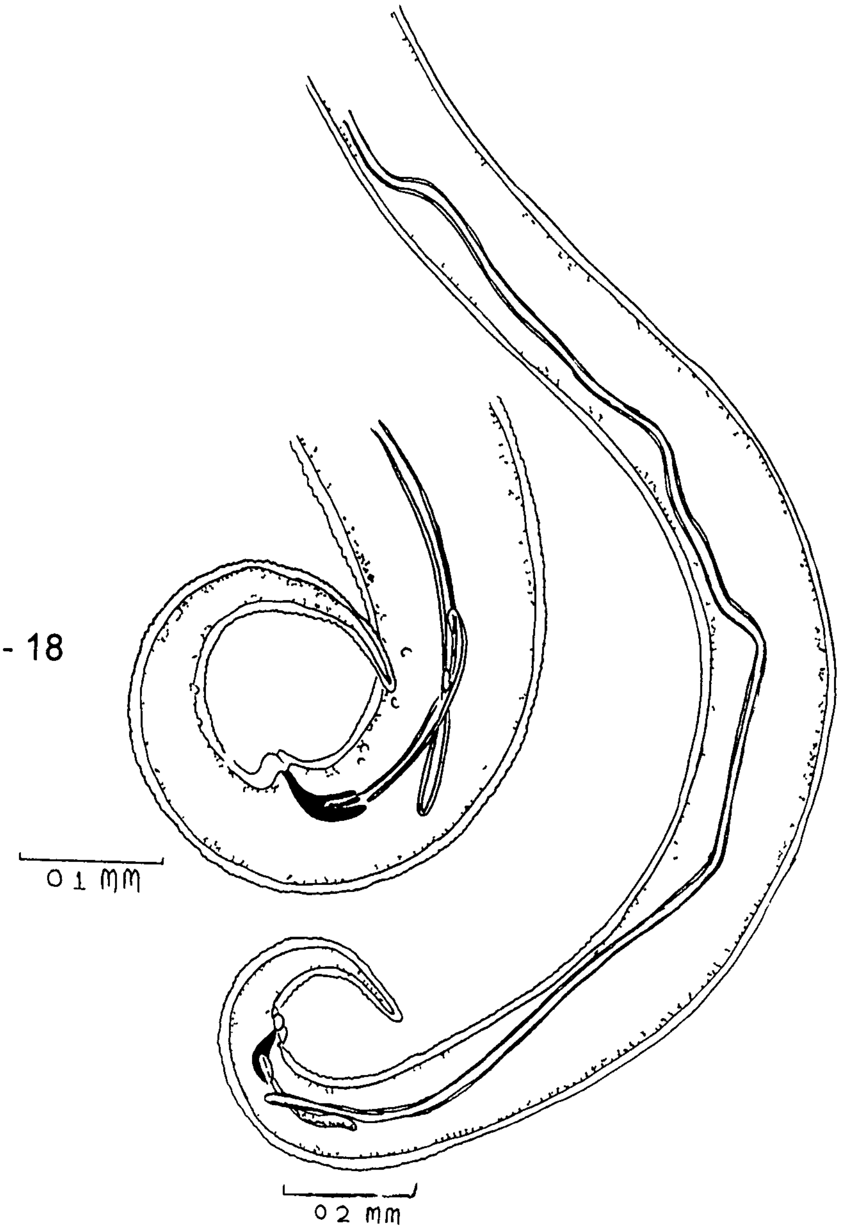


FIG. - 18

FIG. - 19

PLATE 10

Explanation of figures

Exyspirura mehransis n.sp.

Fig. 20 Posterior region of male lateral view.

Fig. 21 Posterior region of female lateral view.

PLATE 10

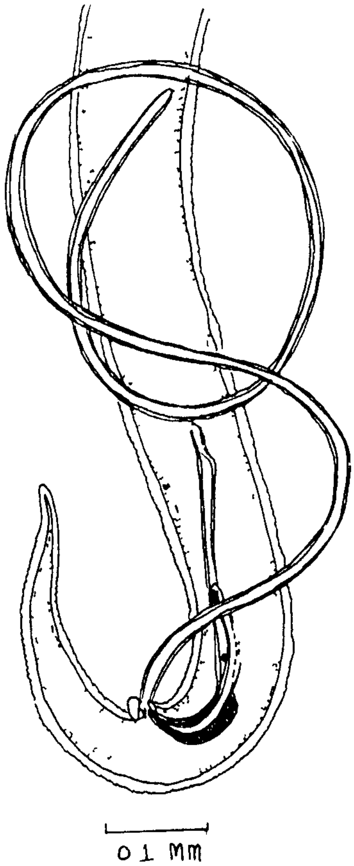


FIG. - 20

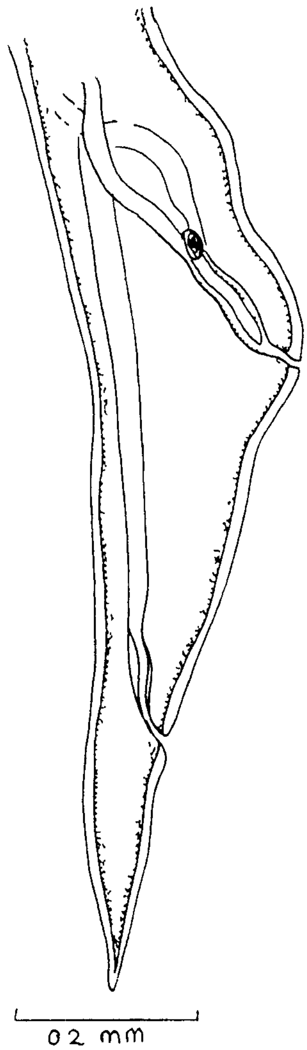


FIG. - 21

CHAPTER VIII

Arthrocephalus herpestis Khera, 1956

ARTHROCEPHALUS Ortlepp, 1925

The genus Arthrocephalus was created by Ortelepp (1925) for the genotype A. gambiensis obtained from mongoose in South Africa. New genus supported by the buccal capsule composed of chitinous parts articulated with each other. He described six plates in the buccal capsule, the largest of which is a complete funnel shaped tube forming the base of the capsule, a single oval plate forms the anteroventral wall of the capsule and on either side of this plate are two additional plates forming, the dorso-lateral and ventro lateral wall of the capsule respectively.

The two ventro-lateral plates did not meet in the mid-ventral line but they were remain separated by a V shaped space. The diagrams of Arthrocephalus were unfortunately not well labelled, so it was very difficult to identify some of the structures. Rao's (1939) redescreption of A. gambiensis with unlabelled diagrams were equally unhelpful in identifying the various structures of the buccal capsule.

Vaz, 1935 describe another species A. maxillaris (Molin, 1861) in Procyon cancrivorus from Brazil. A. lotoris (Schwarz, 1925) Chandder, 1942 synonyms Arthrocephalus sp. Leigh 1940 in Procyon lotor lotor, Bassariscus astutus flavus, Mephitis mephitis, Webster (1956) proposed a new genus Placoconus for this species. Khera, 1956 added a new species A. herpestis from the host Herpestes smithii in Lucknow. He presented detail key to the species of Arthrocephalus on the basis of presence and absence of ventral lancets, bifurcation of the dorsal ray with two or tridigitate being straight on L shaped and length of spicules with accessory piece.

Anthrocephalus herpestis Khera, 1956

(Plate 11 Fig. 22, 23; Plate 12 Fig. 24, 25, 26)

Five specimens, two males and three females were recovered from the intestine of ruddy mongoose, Herpestes smithii smithii Gray at Kuthulia farm Rewa.

The body of the worms are soft, thin, delicate and small in size about 6-9.5 mm. in length. The cuticule is thin, delicate and indistinctly striated. The striations are 0.004-0.007 mm. apart from each other. The anterior extremity is bent dorsally.

The buccal capsule of the parasite is longer than the broad. It measures from about 0.12 to 0.123 in length and 0.07 to 0.75 mm. in breadth in female and about 0.1 to 0.11 in length and 0.07 to 0.73 mm. in breadth in male parasite. The buccal capsule consists of six articulated cuticular plates. The mouth of the worm is surrounded by a paired dorso-lateral and a paired anterio-ventral plates. When seen from the lateral side, the dorso-lateral and anterio-ventral plates gives triangular appearance. There is a single ventral plate. The sixth plate is the largest of all the plates. It forms the base of the capsule and has shape like that of a truncated funnel. The truncated edge of this plate rests on the oesophagus. The inner surface of the buccal capsule is smooth except for a few faint longitudinal ridges on the dorso-lateral and anterio-ventral plates. The basal plate is funnel shaped which is pierced by the duct of the oesophageal gland, and forms a large, prominent dorsal cone.

The buccal capsule leads into a club shaped muscular oesophagus. The oesophagus measures 0.625 - 0.65 mm. long in female and 0.52 - 0.54 mm. long in male worm. These are 1/12 - 1/14th in the ratio of the total body length. The oesophagus communicates with the moderately broad intestine through three flattened oesophageo-intestine values.

The intestine is some what narrower than the posterior portion of the oesophagus. It consists of thick muscular walls and have a very narrow lumen. The cells of intestinal wall are small and indistinct. The intestine leads into a very short and narrow rectum which is lined internally by the internal cuticle. The rectum opens to the exterior by the anus in female, and in the male it open into the cloaca which also receives the genital duct. The rectum measures 0.05 mm. in length in females. The three oval rectal gland cells are present at the junction of the intestine and the rectum. These cells are granular with a large and prominent nucleus in the centre.

The minute cervical papillae are located at the distance of 0.36 mm. from the anterior end of female and 0.39 mm. in the male worm just behind the nerve ring. The broad nerve ring is situated at the distance of 0.3 - 0.33 mm. from the anterior end in the female and 0.29 in the male worms.

The excretory pore is situated in the oesophageal region at a distance of 0.5 mm. from the anterior end in the female and about 0.48 mm. in the male worms.

MALE CHARACTERS

(Plate 11 Fig.22 Plate 12 Fig.26)

The male worms are smaller than the female. They measures from 6.2 - 6.85 mm. in length and 0.15 - 0.16 mm. in diameter. The bursa has a small dorsal lobe and large lateral lobes. The ventral ray is cleft. The externo - lateral and anterio - laterals arising from a common trunk. The externo-dorsal originates from a common trunk near the base of dorsal stem. The dorsal ray is stout. It is bifurcated distally. Each bifurcation devide to form tridigitate. The external digit of each bifurcation is L shaped. All the three digits of each bifurcation are fine, thin and elongated.

The spicules are equal, thin and filiform. They measures 0.25 - 0.26 mm. in length. At the base of the spicules there is a tube like accessory piece, through which the spicules pass. The accessory piece measures 0.034 - 0.036 mm. in length and 0.016 - 0.017 mm. in maximum breadth. The spicules which come out from the accessory piece are knobbed proximally and slightly curved distally.

FEMALE CHARACTERS

(Plate 11 Fig. 23 Plate 12 Fig. 24, 25)

The female worm is thin and longer than the male and measures 8.12 - 9.5 mm. in length and 0.16 - 0.165 mm. in diameter. The tail of female is conical having a small spike on terminal end. The tail measure about 0.125 mm. in length. The spike present on the posterior end of tail measures 0.13mm. in length. A single papilla is situated on the dorsal side of the tail at the distance of 0.06mm. from the posterior end.

The vulva is a conspicuous transvese slit like structure with thick cuticular walls. The vulva is situated at the distance of 5.43 mm. from anterior end in the specimen measuring about 7.93 mm. in length; i.e. nearly at the junction of the middle and posterior third of the body. The vagina is a short tube like measuring about 0.05 mm. in length which leads into opposed on ovijectors. The ovijector open into uterine tube coming from opposite side. The uterine tubes are straight and uncoiled.

There are two ovaries joining the anterior uterine tube known as superior ovary and other connected the posterior uterine tube called as inferior ovary. The superior ovary coming from the posterior third of the body at the level with middle of the posterior uterus. It passes cephalad as far as 0.85 mm. behind the posterior end of the oesophagus and then caudad to a little infront of the anus. It again cephalad to about 0.85 mm. behind the oesophagus and finally joins the anterior uterine tube in the anterior third of the body. The inferior ovary arises 0.95 mm. behind the posterior end of oesophagus. It passes caudad to the point of origin of the other ovary, returns cephalad to 0.85 mm. behind the oesophagus, curves again to the lavel of anus and finally joins the posterior uterine tube in the posterior third of the body.

The eggs are oval and thin-shelled. They are in multicellular stage of development at the time of egg laying. The fully developed eggs are measured 0.056 - 0.06 in length and 0.03 - 0.038 mm. in diameter.

Host	-	Herpestis smithii smithii
Location	-	Intestine
Locality	-	Kuthulia form, Rewa.

DISCUSSION

Only four species of the genus Arthrocephalus has been described all over the world e.i. Agambiensis Ortlepp 1925; A.herpestis Khera, 1956; Alotoris (Schwarz, 1925), Chander 1942, Synonyms Arthrocephuls sp. Leigh, 1940; and A.maxillaris (Molin, 1861) vaz. 1935.

In the description of A.gambiensis Ortlepp 1925 given unlabelled diagrams which makes difficult to identify some of the structure.Rao's (1939) redescribe A.gambiensis with again unlabelled diagrams, which were equally unhelpful in identyfying the various structures in the buccal capsule. Consequently the author made a detailed study of the buccal capsule and found that -

1. There is a pair of anterio-lateral plates instead of a single plate in the buccal capsule.
2. There is a single complete ventral plate instead of paired ventro-lateral plates separated by a V shaped space.

Inspite of the avobe described differences, the present worm comes closer to A.gambiensis from which it differs in the size of the buccal capsule in the ratio of the length of the oesophagus to the length of body, in the spicules and the size of the accessory piece in possessing an L-shaped external digit and in the tridigitate bifurcation on the dorsal ray.

This worm closely ressembles to A.herpestis Khera 1956 in size and structure of buccal capsules in ratio of length of oesophagus and body of worm, in size of spicules, accessory piece, in having L shaped external digit and in tridigitate bifurcation of dorsal ray. But there are minor differences in the length, size of body and various organs, which are considered as individual variations within the species.

PLATE 11

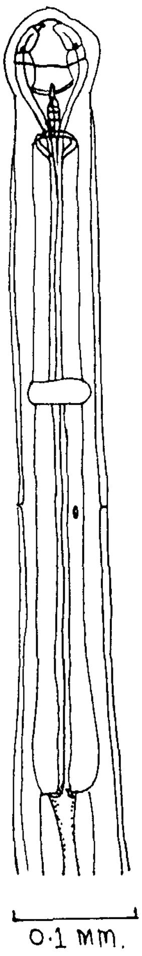
Explanation of figures

<u>Arthrocephalus</u> <u>herpestis</u> Khera, 1956

Fig. 22 Anterior region of male.
Ventral view.

Fig. 23 Head of female.
Lateral view.

PLATE 11



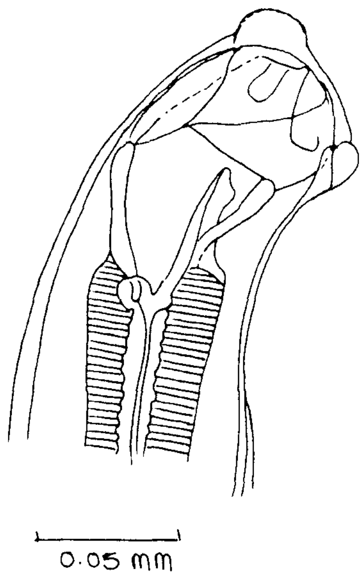


FIG. - 23

FIG. - 22

PLATE 12

Explanation of figures

Arthrocephalus herpestis Khera, 1956

Fig. 24 Tail region of female.

Fig. 25 Vulvar region of female.

Fig. 26 Bursa of male.

PLATE 12

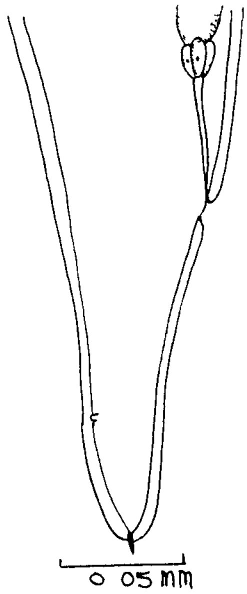


FIG. - 24

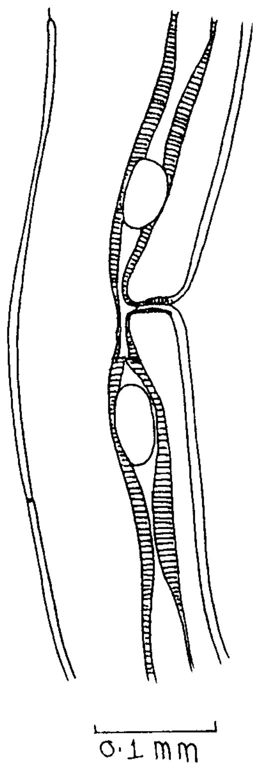


FIG. - 25

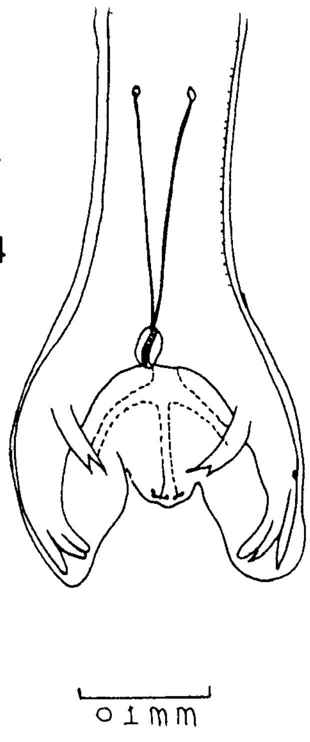


FIG. - 26

SECTION - B

PLANT PARASITIC NEMATODES

TABLE III

SYSTEMATIC LIST OF THE PLANT HOST EXAMINED

Host & its systematic Position	No.of Host		Nematode Recovered
	Examined	Infected	
1	2	3	4
ANGIOSPERMS			
Monocotyledons			
Fam. Graminae			
1. Doob grass (*Cynodon decatylon* Pers).	12	10	*Helicotylenchus jenkinsis* n.sp. *Hopolimus indicus* *Tylenchus* sp. *Hetrodera* sp.
2. Maize (*Zea mays* Linn.)	20	20	*Tylenchorhynchus* sp. *Hoplaimus indicus*
3. Bajra (*Pennisetum thphoides* Rich)	10	Nil	Nil
4. Paddy (*Oryza sativa* Linn.)	15	9	*Aphelenchoides* sp.
5. Barley (Joa) (*Hordeum vulgare* Linn.)	5	Nil	Nil
6. Wheat (*Triticum vulgare*)	9	6	*Tylenchorhynchus* sp.

1	2	3	4
7. Jowar	12	8	Heterodera sp.
(Sorghum vulgare)			
Fam.- Liliaceae			
8. Onion (Pyaj)	14	12	Meloidogyne javanica
(Allium cepa Linn.)			
Fam.- Pontederiaceae			
9. Jalkumbhi	5	Nil	Nil
(Eichhornia crassipes Solms.)			
Fam.- Musaceae			
10. Banana	3	1	Meloidogyne sp.
(Musa Paradisiaca Linn.)			
DICOTYLEDONS			
Fam.-Caricacae			
11. Papaya	13	10	Pratylenchus thornensis n.sp.
(Carica papaya L.)			
12. Spinach (Palak)	5	20	Meloidogyne sp.
(Spinacia oleracea Linn.)			

1	2	3	4
13. Garden Croton (*Codiaeum veriegatum* Blume)	20	14	*Tylenchorhynchus indicus* n.sp. *Meloidgyne* sp. *Seinura* sp. *Aphelenchoides* sp. *Rotylenchus reniformis*
Fam.- Cruciferae			
14. Cauliflower (*Brassica oleracea* var. botrytis Linn.)	7	Nil	Nil
15. Mustard (*Brassica compestris* Linn)	12	Nil	Nil
16. Cabbage (*Brassica oleracca* var *Capitata* L.)	6	2	*Meloidogyne Javanica* *Hoplolaimus indicus*
17. Radius (*Raphanus safivis* L.)	6	3	*Aphelenchus* sp. *Meloidogyne* sp.
Fam.- Cucurbitaceae			
18. Kaddu (*Cucurbita maxima* Duch.)	8	Nil	Nil

1	2	3	4
19. Taroi (Luffa Cylindrica Mill.) Fam.- Leguminosae	6	2	Meloidogyne sp.
20. Bean (Dolichoslablab L.)	25	20	Meloidogyne incognita Hoplolaimus indicus Sher, 1963
21. Lobia (cowpea) (Vigna sinensis L.) Endl.)	18	10	Meloidogyne javanica Aphelenchus sp. Tylenchorhynchus sp.
22. Lady finger (Abelmoschus esculentus Monech.) Fam.- Nyctaginaceae	21	15	Tylenchus rewanscs n.sp.
23. Baigainvillea (Bougainvilea sp.) Fam.- Solanaceae	6	4	Xiphinema basiri, Siddiqi, 1959 Helicotylenchus sp.
24. Brinjal (Solanum melongena Linn.)	40	25	Seinura sasseris n.sp. Hoplolaimus indicus Meloidogyne javanica

1	2	3	4
25. Potato (*Solanum tuberosum* Linn.)	25	15	*Ditylenchus* sp. *Meloidogyne Javanica*
26. Chilli (*Capsicum frutescens* Linn.)	2	Nil	Nil
27. Tomato (*Lycopersicum esculentum*)	29	25	*Tylenchorhynchus* sp.
Fam.- Umbelliferae			
28. Coriander (*Coriandrum sativum* Linn.)	7	Nil	Nil
29. Carrot (*Daucus carota* L.)	12	6	*Meloidogyne javanica*

LIST OF INDICES USED IN THE DESCRIPTION OF VARIOUS GROUPS OF PLANT NEMATODES

a	=	Body length/Maximum body width.
b_1	=	Body length/Distance from anterior end to base of median oesophageal bulb.
b	=	Body length/Distance from anterior end to the junction of oesophagus and intestine.
b'	=	Body length/Distance from anterior end to posterior end of oesophageal glands.
B	=	Maximum wideth of median oesophageal bulb/Length of median oesophageal bulb.
c	=	Body length/Tail length.
c'	=	Tail length/Anal body width (ABW).
EO	=	Length of body anterior to the excretery pore expressed as percentage of the length of the oesophagus to the posterior end of the lobe.
G_1	=	Extent of anterior genital tract expressed as a percentage of body length.
G_2	=	Extent of posterior genital tract expressed as a percentage of body length.
Guiding ring	=	Distance from anterior end (μm).

Gubernaculum	=	Length (μm)
Rexp.	=	Number of annules from anterior end to opening of excretory pore.
Roes	=	Number of annules from anterior end to total length of oesophagus.
Rst	=	*Number of annules from anterior end to* base of spear.
Rvan	=	Number of annules from vulva to anus.
RV	=	Number of annules from posterior end to vulva.
Spear	=	Length (μm).
Spicule	=	Length (μm).
SP/L	=	Spicule length/Total body length in male.
T	=	Distance between cloaca and anterior most part of testis expressed as a percentage of body length.
V	=	Position of vulva expressed a percentage of body length.
V'	=	Position of vulva expressed as a percentage of distance from anterior end to anus.
VL/VB	=	Distance from terminus to vulva/Body width of Vulva.

H	=	Hyaline area between the cuticle and the body contents in the tail terminus.
Hem-EP	=	Distance between hemizonid and excretory pore.
L	=	Length of body (μm).
L'	=	Distance between head to anus (μm).
L/EP	=	Body length/Distance from anterior end to the excretory pore.
L/Hem	=	Body lenght/Distance from anterior end to the hemizonid.
M	=	Anterior part of spear expressed as a percentage of spear length.
MB	=	Position of median oesophageal bulb expressed as a percentage of total oesophageal length.
O	=	Distance of dorsal oesophageal gland orifice from spear base expressed as a percentage of spear length.
Odontophore	=	Length (μm).
Odontostyle	=	Length (μm).
PO	=	Length of oesophageal lobe expressed as a percentage of total oesophagus length.
R	=	Total number of body annules.

Ran.	=	Annules on which anus is located, counting from terminus.

SYSTEMATIC LIST OF THE PLANT NEMATODE DESCRIBED

The classification which is given here is by Golden (1971) and Siddiqi (1980).

PHYLUM

(A) CLASS	-	Nematoda Rudolphi, 1808
	-	Secernentea (Von Linstow,1905) Doutherty, 1958 (Syn.-Subclass - Phasmidia Chitwood & Chitwood, 1933
1. Order	-	Tylenchida (Filipjev, 1934) Thorne, 1949. (Syn.- Heteroderata (Filipjev 1934, Skarbilovich, 1957).
I Sub order	-	Tylenchina (Orley, 1880) Geraert, 1966 (Syn. in part) Hoplolaimoides (Filipjev,1934) Paramonov, 1967).
I Super family	-	Tylenchoidea (Orley, 1880) Chitwood & Chitwood, 1937
(a) Family	-	Tylenchidae Orley, 1880
Sub Family	-	Tylenchinae (Orley, 1880) Marcinowski, 1909

Genus	-	*Tylenchus* bastian, 1865
Species	-	*T. rewansis* n.sp.
Super family	-	Hoplolaimoidea (Filipjev,1934) Paramonov, 1967
(a) Family	-	Tylenchorhynchidae (Eliava 1964) Golden, 1971.
Sub-family	-	Tylenchorhynchinae Eliava 1964
Genus	-	*Tylenchorhynchus* Gobb, 1913
Species	-	*T. indicus* n.sp.
(b) Family	-	Pratylenchidae (Thorne,1949) Siddiqi, 1963
Sub-family	-	Pratylenchinae Thorne, 1949
Genus	-	*Pratylenchus* Filipjev, 1936
Species	-	*P. thornensis* n.sp.
(c) Family	-	Hoplolaimidae (Filipjev,1934) Wieser, 1953
Sub-family	-	Hoplolaiminae Filipjev, 1934
Genus	-	*Hoplolaimus* Daday, 1905

Species	-	H. indicus Sher, 1963
Sub family	-	Rotylenchinae Golden, 1971
Genus	-	Helicotylenchus Steiner, 1945
Species	-	H. jenkinsis n.sp.
2. Order	-	Aphelenchida Siddiqi, 1980
Sub order	-	Aphelenchina, Garaert 1966
Super family	-	Aphelenchoideoidea (Skarbilovich, 1947) Siddiqi, 1980
Family	-	Aphelenchoididae (Skarbilovich, 1940) Paramonov, 1953
Sub family	-	Seinurinae (Husain & Khan 1967) Baranovskaya 1981
Genus	-	Seinura Fuchs 1931
Species	-	S. sasseris n.sp.
(B) CLASS	-	Adenophorea (Von Linstow,1905) Chitwood, 1958 (Syn.-Subclass-Aphasmidia Chitwood & Chitwood, 1933).

(1)	Order	-	Dorylaimida (de Man, 1876) Pearse, 1942
(i)	Sub Order	-	Dorylaimina (Chitwood, 1933) Pearse, 1936
I.	Super family	-	Dorylaimidea (de Man, 1976) Thorne, 1934
(a)	Family	-	Longidoridae (Thorne, 1935) Meyl, 1961
	Sub family	-	Xiphinematinae Dalmasso, 1969
	Genus	-	<u>Xiphinema</u> Cobb, 1913
	Species	-	<u>X</u>. <u>basiri</u>, Siddiqi 1959.

CHAPTER IX

Tylenchus rewansis n.sp.

TYLENCHUS Bastian, 1865

The genus Tylenchus was established by Bastian, 1865. Andrassy (1954) recognized twenty species, for which he proposed four subgenera: Tylenchus, Aglenchus, Filenchus and Lelenchus. Andrassy has also given a key of twenty species, known at that time. In the 20th century many species were described under the generic name Tylenchus, so that the number of specific and subspecific taxa in genus has increased to two hundred.

Filipjev (1934, 1936) in his classification of subfamily Tylenchinae seperated two genera Anguillulina and Tylenchus and proposed further four genera; Ditylenchus, Tetrylenchus, Rotylenchus and Pratylenchus for a part of the species of the old genus Tylenchus. He included twenty two species in the genus and designated Tylenchus davainii Bustian, 1865 as the type species. Goodey (1962) established another subgenus cephalenchus. Siddiqi (1963) placed Miculenchus Andrassy, 1959 as subgenus under Tylenchus.

Thorne (1969) amended the generic diagnosis given by Filipjev and rejected Andrassy's subgenera, considering Tylenchus as homogenous unit. Meyl (1961) raised them to generic rank. Baker (1962) supported Meyl proposal. Then three more genera were added to the genus viz. clavilenchus Jairajpuri 1966; Ottolenchus Husain and Khan, 1967 and Jrantylenchus Kheiri, 1972. Later on in 1968 Thorne and Malek raised the subgenus Clavilenchus to generic level and Bagri and Jairajpuri (1969) accepted this elevation. Brzeski (1968) presented a key to genus Tylenchus and listed thirtyone valid species. Wu (1970) upgraded the subgenus Ottolenchus to generic level.

In the classification of Tylenchida Golden (1991) redefined Tylenchus to limit it to Andrassyis (1954) subgenera Tylenchus, Filenchus and Lenlenchus. In his detailed monograph on Tylenchida paramonov (1972) recognised Anglenchus as valid genus but left Tylenchus, Filenchus and Lelenchus as subgenera with twentyfour valid species. Siddiqi (1971) and Dekar (1972) on the other hand proposed generic status to all the former subgenera. Bello (1971 & 1973) supported the Siddiqi's concept and considered thirty four and thirty valid species respectively.

From India, four species of the genus have been described by Siddqi (1963), Mahajan (1973) and Singh and Jain (1982).

Tylenchus *rewansis* n.sp.

(Plate 13 Fig 27,28 Plate 14 Fig 29,30 Plate 15 Fig 31,32)

Seventeen Females (Paratypes)-

L	=	0.47 (0.42-0.53)mm	;	a	=	26.20(20.10-31.79)
b	=	13.6 (10.7-21.9)	;	b	=	5.89(5.42-6.79)
b	=	5.7 (5.35-6.5)	;	B	=	0.66(0.45-0.89)
G_1	=	37.8 (28.9-43.6)	;	G_2	=	4.8(4.03-6.7)
C	=	4.9 (4.03-6.8)	;	C^1	=	11.6(9.2-18.0)
V	=	61.8 (38.5-78.3)	;	V^1	=	88.5(48.4-92.5)
VL/VB	=	10.9 (6.8-15.5)	;	MB	=	43.2(23-53)
Spear	=	10 (7-13)	;	PO	=	52.37(47.90-59.35)

Female (Holotype)

L	=	0.52 mm	;	a	=	31.81
b	=	14.51	;	b	=	5.91
b^1	=	5.91	;	B	=	0.83
G	=	42.51	;	G_2	=	3.55
C	=	6.31	;	C^1	=	11.51
V	=	64.91	;	V^1	=	77.81
VL/VB	=	10.51	;	MB	=	40.61
Spear	=	11μm	;	PO	=	59.31

Two Male (Paratype)

L	= 0.46 (0.46 - 0.48)mm ;	a	= 24.20 (24.19 - 24.21)
b_1	= 11.04 (11.03 - 11.05);	b	= 5.65 (5.64 - 5.86)
b'	= 5.52 (5.51 - 5.53) ;	B	= 0.70 (0.69 - 0.71)
C	= 3.71 (3.70 - 3.72) ;	C'	= 10.51 (10.50 - 10.52)
T	= 51.70 (51.70 - 51.71);	SP/L	= 0.03 (0.29 - 0.03)
Gubernaculum	= 6 µm ;	MB	= 50 (49 - 51)
Spicule	= 14 µm ;	Spear	= 12 (11.98 - 12.12)

FEMALE CHARACTERS

(Plate 13 Fig. 27; Plate 15 Fig. 31,32)

Body is slightly arcuate ventrally tapering from the base of the oesophagus to the lip region anteriorly and from vulval region to the tail tip posteriorly. Cuticle is strongly striated with 6-8 triae present at the mid body region. Lateral fields marked by four incisures and occupy 1/4th of the corresponding body width.

Lip region is continuous with the body, 2-3 µm high and 5.6 µ wide. It bears 2-4 annules. The cephalic framework is weak. Spear is well developed and strongly knobbed. It measures 6.00 - 12.00 µm in length with posteriorly directed knobs. Telechium is shorter than metenchium. Orifice of dorsal oesophageal gland is located about 2 - 3 µm behind the base of spear.

Procorpus is 17-26 µm long, narrow, cylindrical and joins the oval median oesophageal bulb. In the middle of the bulb the sclerotized valve is situated. Basal gland is pyriform with an large nucleus. Isthumus is slender and longer than basal bulb. Rectum is longer than anal body width and measures 7-16 µm.

Nerve ring present posterior to median oesophageal bulb and measures 40-55 µm from the anterior end. Excretory pore is present 62-69 µm from the anterior end. In holotype hemizonid is not seen.

Genital tract is monodelphic and out stretched, with oocytes usually arranged in single file. Posterior uterine branch rudimentary, shorter than body diameter. Valva is transverse slit like. Vagina 5-11 µm long and about one half to one third of the vulval body width. Post-vulval uterine sac is round, rudimentary, shorter than body width. The distance between vulva anus is a slightly longer than the tail length.

Tail is elongated, slender, filiform, slightly ventrally curved with pointed tip. It measures 73-75 µm in length.

MALE CHARACTERS

(Plate 13 Fig 28 Plate 14 Fig 29,30)

Body is shorter than female. It measures 0.46mm in length. Lip region slightly striated and set off by a slight narrowing of body contour. Testis single, out streched. Spermatocytes are arranged in a single row. Spicules are of usually tylenchoid type which measure 14 µm in length. Sperms are rounded. Gubernaculum straight, thickned near middle and 6 µm long. Bursa crenate on margin, about three times as long as anal body diameter. Tail slender and long.

Habitat:- The specimen collected from amount the rhizosphere of lady finger, Abelmoschus esculentus.

Locality:- Teonther, Rewa.

DISCUSSION

According to key given by Andrassy (1979) the present new form very much close to the Tylenchus sandneri Wasilewska, 1965; Tylenchus butteus Thorne and Malik, 1968, Tylenchus kashmirensis Mahajan 1973 and Tylenchus stylolineatus Wu 1969.

The present new parasite can be separated from *Tylenchus sandneri* in having longer body, lower value of 'a', higher value of 'b' and 'c' and lower value of 'c'. Tail terminus is pointed. In *Tylenchus sandneri*

L = 0.39 - 0.47 mm;

a = 30 - 43; b = 4.04 - 4.80,

C = 7.5 - 0.2 ; c^1 = 5.5 - 7.00

in length.

The new species closely resembles with *Tylenchus butteus* but differs in having higher value of 'b' and c'. In the case of *Tylenchus butteus* b = 4.60 and C' = 10 m in length.

The present form nearer to *Tylenchus kashmirensis*, but in the other hand differs in having shorter body length, higher value of 'b' and c' and shorter spear. In *Tylenchus kashmirensis* L = 0.67 - 0.71 mm; b = 4.5 ; c' = 5-6 and spear = 16mm in length.

The new species resembles with that of *Tylenchus stylolineatus* but can be differentiated in having shorter body, lower value of 'a' and shorter spear present in the male. The *Tylenchus stylolineatus* measures as L = 0.50 - 0.68mm, a = 29 - 33 and spear = 19.5 in length.

In view of the above differences, the worm described herein is considered to be a new species. The new species has been named after the name of district Rewa, Madhya Pradesh.

PLATE 13

Explanation of figures

Tylenchus rewansis n.sp.

Fig. 27 Entire body of female.

Fig. 28 Entire body of male.

PLATE 13

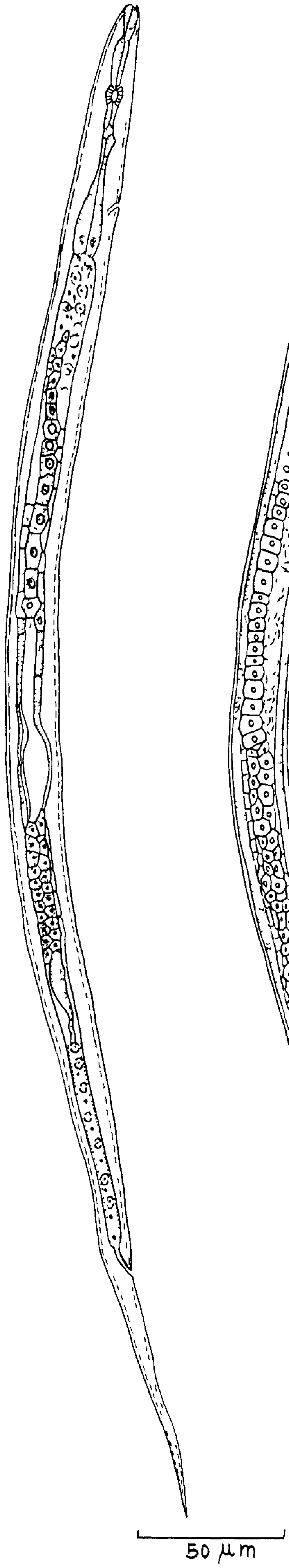


FIG - 27

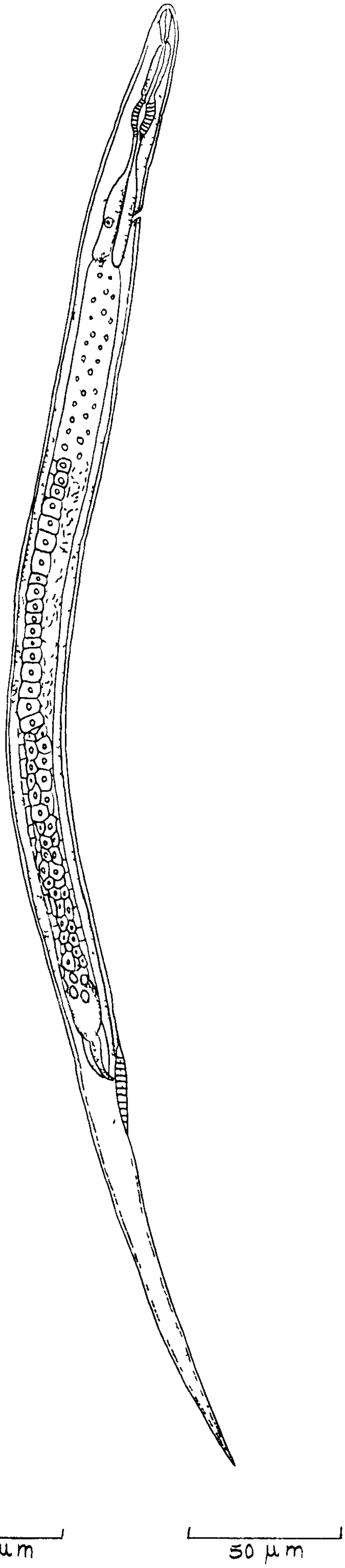


FIG - 28

PLATE 14

Explanation of figures

Tylenchus rewansis n.sp.

Fig. 29 Tail region of male.

Fig. 30 Anterior region of male.

PLATE 14

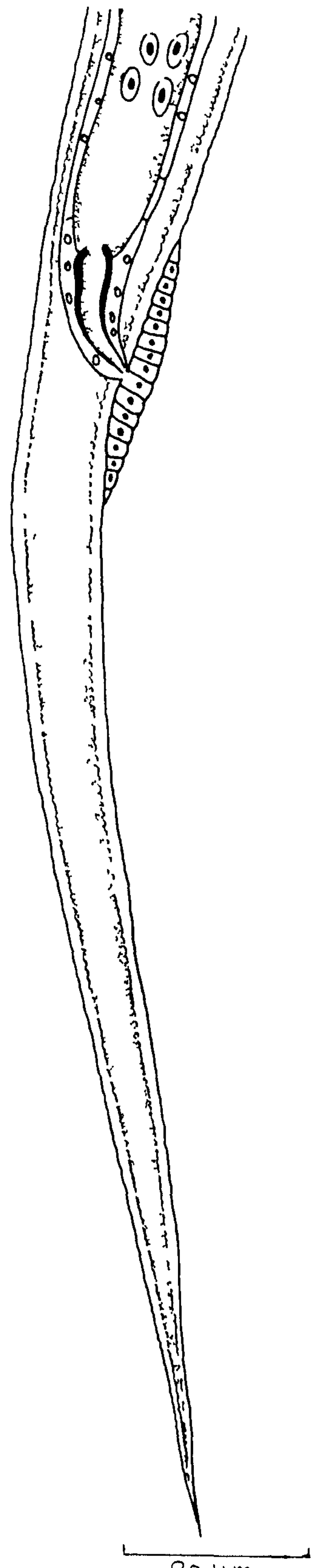


FIG - 29

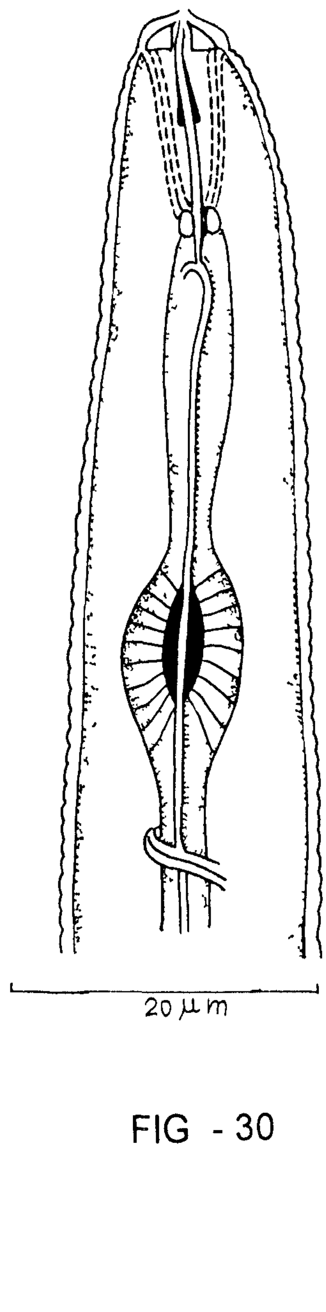


FIG - 30

PLATE 15

Explanation of figures

Tylenchus rewansis n.sp.

Fig. 31 Anterior region of female.

Fig. 32 Tail region of female.

PLATE 15

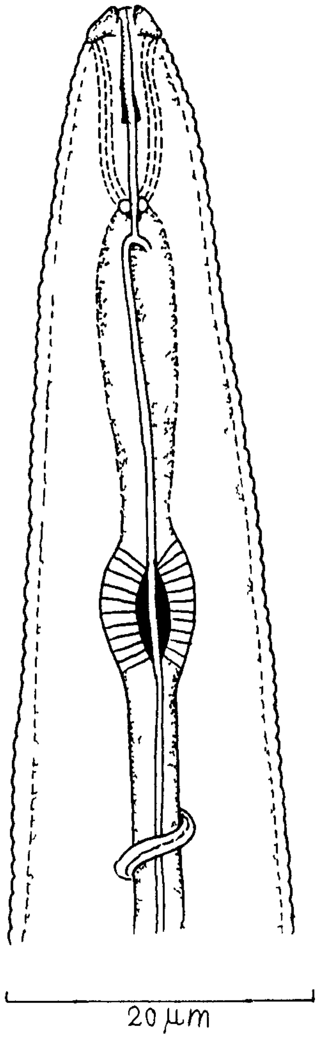


FIG. - 31

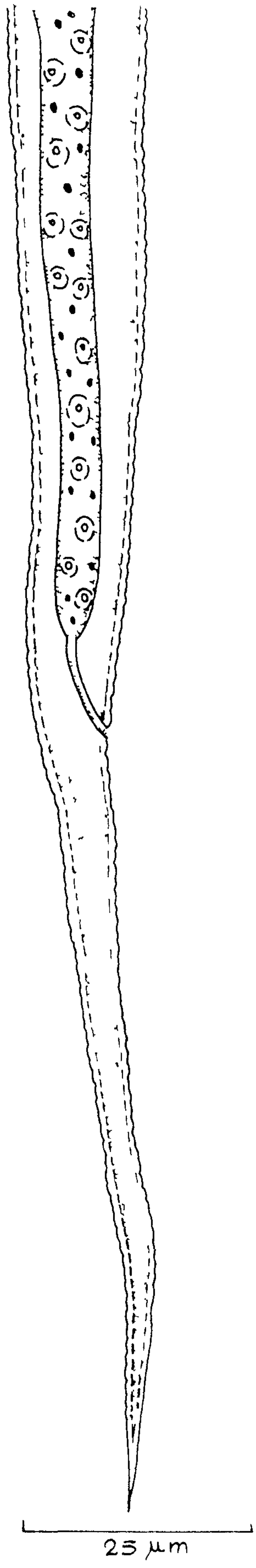


FIG - 32

CHAPTER X

Tylenchorhynchus indicus n.sp.

TYLENCHORHYNCHUS Cobb, 1913

The genus Tylenchorhynchus was established by Cobb in 1913 when he described the species T. Cylindricus. In 1945 the common name "stylet" nematodes was proposed by Steiner for the members of the genus Tylenchorhynchus. But the recent years the name "stunt" has become more popular. Allen (1955) assembled many scattered references in a generic monograph and added twenty-two new species to the twelve species already described. Filipjev (1936) made Tylenchorhynchus cylindricus a synonyms of T. dubius. Thorne (1949) accepted Filipjev proposal and emended the generic and specific descriptions, which was published under the correct name T. cylindricus. Allen in his excellent review of the genus Tylenchorhynchus concluded that T. dubius and T. cylindricus were two different species hence T. cylindricus Cobb, 1913 was re-established as a valid and type species. Allen's publication is important because it provide the criteria upon which the taxa within this group are recognized. Baker (1962) and deGuinan (1967) included fifty-five and seventy-one valid species in this genus respectively.

In the genus Tylenchorhynchus many new species has been included which showed wide morphological differences. They have now been allocated to new genera viz. Merlinius Siddiqi 1970; Uliginotylenchus Siddiqi 1971; Scutylenchus Jairajpuri 1971; Dolichorhynchus Mulk and Jairajpuri, 1974 and Amplimerlinius Siddiqi, 1976. The proposal of subfamily Merlinae for the genus Merlinius by Siddiqi 1970 has not been accepted by Tarjan (1973) and Andrasay (1976) although well defined and supported by Sher (1974).

Andrassy 1973 included T.clavicaudatus Seinhorst, 1963; T.crassicaudatus Williams, 1960 and Telotylenchoides housei (Raski, Prasad and Swarup, 1964), Siddiqi 1971 into Paratrophurus. However the first two species do not conside with the diagnosis of Paratrophurus as emended by Siddiqi 1971 but they are closely resemble with Tylenchorhynchus. Although, T.crassicaudatus was synonymised with T.mashoodi by Bagri and Jairajpuri 1970.

Targan (1973) presented a very useful contribution regarding synopsis of the species and genera within the family Tylenchorhynchidae which helped to clarify the status of some genera within this group. The latest emended key of the genus has been given by Hooper (1978) which includes fifty five valid species. Since then Eighteen new species of Tylenchorhynchus have been described.

In first record of Tylenchorhynchus sp. in India was published by Siddiqi and Basir (1959). Since then several species of this genus have been reported by Das (1960); Siddiqi (1961, 1963); Seshadri et al. (1967); Sethi and Swarup (1968); Bagri and Jairajpuri (1970); Fotedar and Mahajan (1971); Singh (1971); Khan and Nanjappa (1972a 1972b), Upadhyay et al. (1972); Mahajan (1974); Singh S.P. (1974); Singh R.V. and Khera (1978); Khan, E. and Darekar (1979); Mathur et al. (1979); Gupta and Uma (1980a & 1980b, 1981a, 1981b & 1981c); Kumar (1982); Rashid and Singh (1972); Siddiqi et al. (1982); Singh and Jain (1982); Siva Kumar and Muthukrishnan (1983) from various provinces of India. The frequency with which new species have been described is indicative of their wide distribution throughout the country.

According to Krusberg, 1959, Klinkenberg 1963; Sharma 1971; Wyss 1973; Bridge 1974; the members of the genus Tylenchorhynchus are ectoparasitic, feeding on epidermal cells and root hairs of growing roots. Juveniles were reported to be endoparasitic while adults ectoparasitic in nature (Hooper, 1959). Singh and Jain (1982) reported *Tylenchorhynchus codiaei* feeding on genera croton (*codiaeum variegatum*). Singh and Upadhyay (1987) recorded two new species of genus *Tylenchorhynchus*, *T. fasciculli* and *T. oryzae* from the rhizosphere of cabbage and rice respectively. According Graham, 1954; Birchfield and Martin, 1956; Swarup *et al*. 1964; Oostenbrink, 1966 and Srivastava *et al*., 1974, the *Tylenchorhynchus* sp. are know to cause reduction in plant growth.

Tylenchorhynchus indicus n.sp.

(Plate 16 Fig.33,34; Plate 17 Fig.35,36,37; Plate 18 Fig.38,39)

Fifteen Females (Paratype)

L	=	0.560 (0.384 - 0.767)mm ;	a	=	20.84 (16.00 - 28.50)
b_1	=	9.08 (6.00 - 11.80) ;	b	=	5.15 (4.10 - 7.00)
b^1	=	5.48 (4.41 - 8.68) ;	B	=	0.68 (0.50 - 0.94)
G_1	=	26.97 (14.40 - 33.55) ;	G_2	=	26.16 (16.40 - 35.10)
C	=	14.61 (8.30 - 34.31) ;	C'	=	2.42 (0.79 - 3.00)
V	=	52.61 (44.40 - 66.61) ;	V'	=	58.16 (46.40 - 66.80)
VL/VB	=	10.95 (7.84 - 25.25) ;	m	=	48.43 (31.50 - 61.50)
O	=	27.06 (22.23 - 33.32) ;	MB	=	54.81 (45.4 - 63.10)
Spear	=	15.76 (12.00 - 20.00) µm			

Female (Hototype)

L	=	0.615 mm ;	a	=	26.98
b_1	=	10.97 ;	b	=	6.05
b'	=	5.79 ;	B	=	0.66
G_1	=	30.08 ;	G_2	=	30.88
C	=	16.61 ;	C'	=	2.30
V	=	50.40 ;	V'	=	53.62
VL/VB	=	18.42 ;	m	=	46.65
O	=	23.33 ;	MB	=	52.82
Spear	=	15.00 µm.			

Eleven Male (Paratype)

L	= 0.54 (0.40 - 0.60)mm	;	a	=	26.84 (18.14 - 39.00)
b_1	= 10.27 (6.49 - 14.60)	;	b	=	5.94 (4.70 - 9.00)
B	= 0.72 (0.60 - 0.83)	;	C	=	14.03 (8.79 - 17.50)
C'	= 5.83 (2.11 - 7.71)	;	m	=	49.03 (41.10 - 62.60)
O	= 37.20 (22.58 - 56.00)	;	MB	=	56.26 (49.50 - 71.40)
PO	= 44.93 (39.20 - 50.50)	;	T	=	60.81 (46.70 - 76.89)
SP/L	= 0.033 (0.025 - 0.38)	;	Spear	=	15.20 (10.01 - 22.00) µm.

Spicule = 17.90(13.00-20.00) µm ; Gubernoculum=9.00(6.00-11.00) µm.

FEMALE CHARACTERS

(Plate 16 Fig.34; Plate 17 Fig.35,36,37)

The body generally straight in appearance, sometimes seems to be slightly curved ventrally when relaxed. Cuticle coarsly striated which are divided into segments by longitudinal striae. The lateral fields are marked by four incisures and occupy one third of the body width. The inner two incisures do not meat at tail terminus. The lip region is hemispherical distinctly set off from the body bearing 4-5 annules and a moderately sclerotized cephalic framework. It measures 4.76 (2.50 - 5.00) µm long and 7.60 (5.00 - 14.00) µm wide. The cephalic papillae are so minute that their number and size could not be determined exactly. The spear measures 15.20 (10.00 - 20.00) µ in length with strongly developed rounded basal knobs. In most of the cases telenchium is larger than melenchium. The orifece of dorsal oesophageal gland is 5.00 (4.00 - 6.00) µm. posterior to the spear base.

The procorpus is long tub like, about 33.04 (19.00 - 40.00) µ in length. It joins posteriorly with slightly ovoid median oesophageal bulb which measures 9 - 16 in length and 5 - 14 µm. in breadth. The cresentic larger esophago - intestinal valve is well developed and centrally located. The basal bulb is well developed pyriform with one nucleus measuring 51.56 (32.00 - 60.00) µm. It is situated 115.63 (75.00 - 144.00) µm. from anterior end. Rectum is short and tubular in shape.

The nerve is present at a distance of 70.90 (48-97-85.00) µm from the anterior end. The position of excretory pore is slightly posterior to the nerve ring about 90-55 (60.00 - 119.00) µm from the anterior end. The hemizonid is 2-3 annules long, adjacent to excretory pore.

The genital tract is didelphic. There are two ovaries generally outstretched with oocytes arranged in single row. The vulva slit lies 0.321 (0.215 - 0.463) mm from anterior end. The vagina measures 7 - 17 mm long. The spermatheca is oval in shape and filled with sperms.

The tail is short cylindrical with hemispherical smooth rounded terminus. It measures 40.57 (29.00 - 60.00) µm. Twenty two to eight annules are present in tail. The tail bears prominent phasmids which are present at about 13 - 17 annules anterior to the tail tip.

MALE CHARACTERS

(Plate 16 Fig.33; Plate 18 Fig.38,39)

The male is generally similar to the female in appearance of body shape except for minor differences in measurements. The testis is single, invariably, outstretched. The spicules of the male are short and typical tylenchoid form, measuring about 17.90 (13.00 - 20.00) µm. The gubernaculum is slightly curved and short measures about 9 (6 - 11) µm in length, which is more or less half the length of spicules. Bursa envelope the tail. The tail measures 25.00 - 46.00 µm in length.

Habitat

The specimen recovered from the soil around the roots and inside the roots of garden croton (Codiaeum variegatum).

Locality

Bajrang Nagar, Rewa.

DISCUSSION

According to the key presented by Hooper 1978, the new species is close to Tylenchorhynchus aduncus deGuiran 1967, T. contractus Loof, 1964, T. ewingi hooper, 1959 and T. vulgaris upadhyay, Swarup and Sethi, 1972.

The present species can be distinguished from the Tylenchorhynchus aduncus by possessing slightly smaller spicule and gubernaculum in male and having smaller value of 'a' and larger value of 'c' in the case of female species. The T. aduncus spicule measures 22.25 mm; gubernaculum 13.0 µm; a = 18 - 13 and C = 14 - 17.

The present form resembles with *T. contractus* but differs in having larger body size, higher value of b, c and v and larger spicules. It also differs in having subcylindrical tail and lesser number of lip annules. In *T. contractus* the body length (L) is 0.42 - 0.63 mm; b = 3.8 - 5.00; c = 13 - 15; v = 56 - 60; 5-6 lip annules and spicule = 16-18 um.

The new species comes closer to *T. ewingi* but differs in having larger number of tail annules, larger number of lip annules, lower value of 'a' and higher value of 'c', whereas in *T. ewingi* a = 30 - 35, c = 13 - 16, Lip annule = 3 and Tail annule = 15 - 19.

The present new species closely resembles with *T. vulgaris* but can be differentiated in having longer body length, higher value of 'c', higher value of 'v', lesser number of tail annules, shorter length of spicules and slightly larger gubernaculum. In *T. vulgaris* the length of body (L) = 0.56 - 0.67 mm; c = 14 - 20, v = 52 - 77; spicule = 22 - 25 µm, Gubernaculum = 13 - 16 µm and Tail annule = 35 - 42.

The Writer considers that these differences necessitate to the creation of new species for the worm under discussion. It is proposed to name it *Tylenchorhynchus indicus* n.sp. after the name of our country India.

PLATE 16

Explanation of figures

Tylenchorhynchus indicus n.sp.

Fig. 33 Entire body of male.

Fig. 34 Entire body of female.

PLATE 16

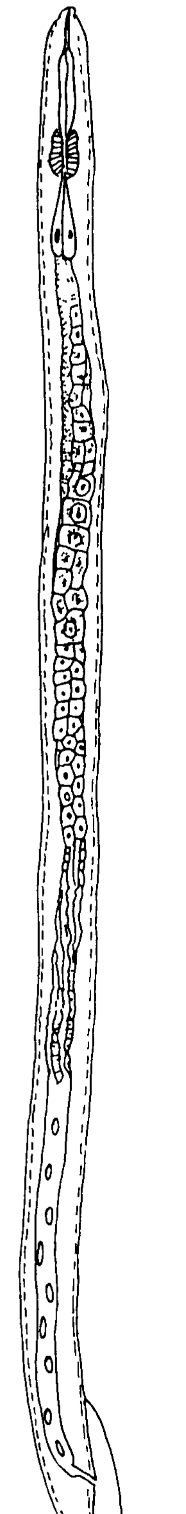


FIG. - 33

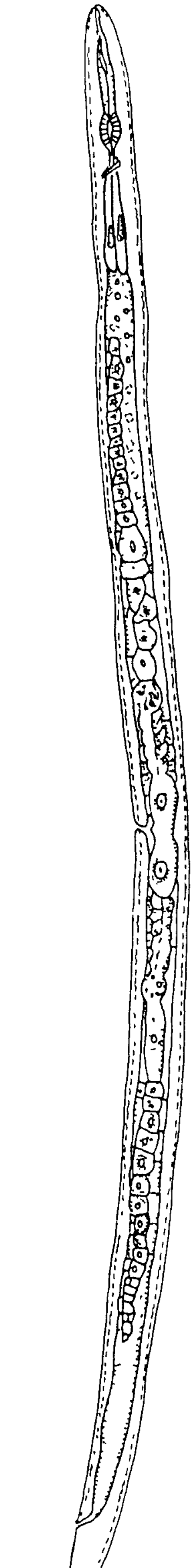


FIG. - 34

PLATE 17

Explanation of figures

Tylenchorhynchus indicus n.sp.

Fig. 35 Anterior region of female.

Fig. 36 Tail region of female.

Fig. 37 Lateral line incisures in tail region.

PLATE 17

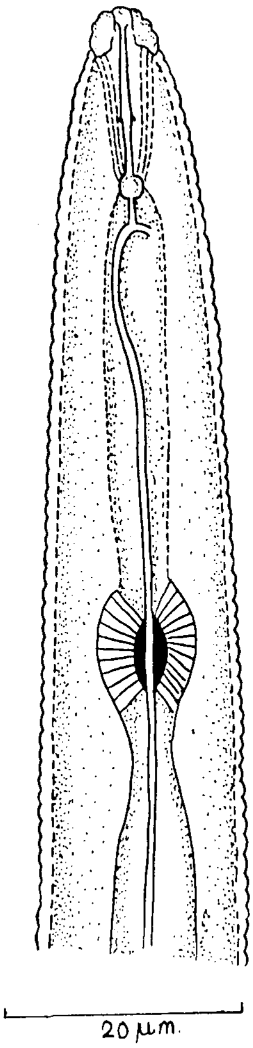


FIG. - 35

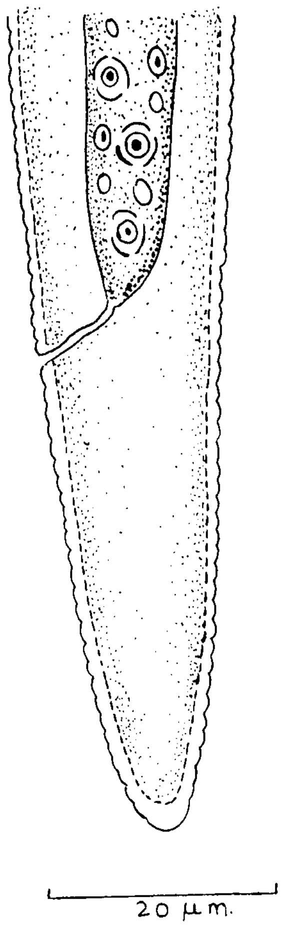


FIG. - 36

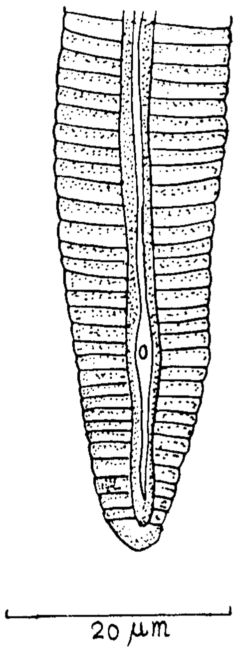


FIG. - 37

PLATE 18

Explanation of figures

Tylenchorhynchus indicus n.sp.

Fig. 38 Tail region of male.

Fig. 39 Anterior region of male.

PLATE 18

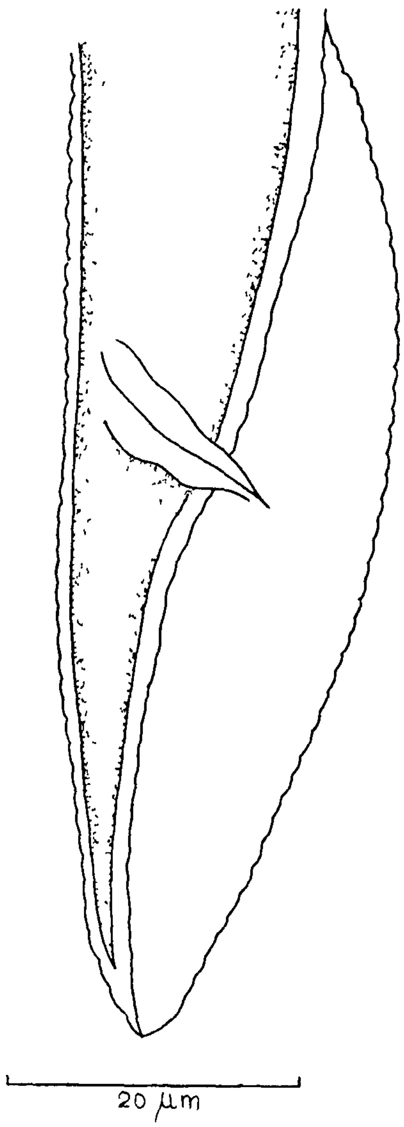


FIG. - 38

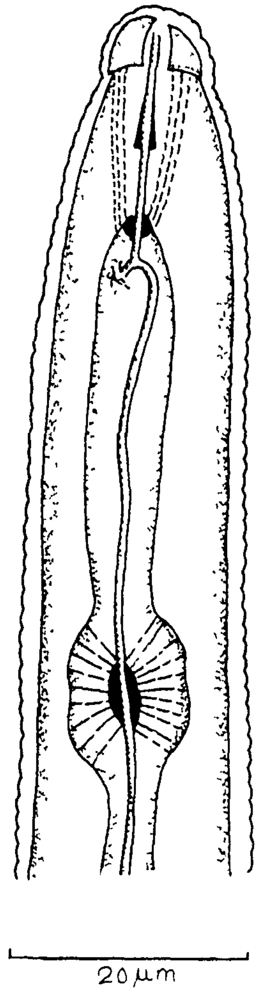


FIG. - 39

CHAPTER XI

Pratylenchus thornensis n.sp.

PRATYLENCHUS Filipjev, 1934

Pratylenchus species were first described as members of the genus *Tylenchus* by various workers until Goffart (1929) and Goodey (1932) assigned them to *Anguillulina* in accordance with taxonomic revision of Baylis and Daubney (1926). Bastian (1865) was the first to observe a member of this group and described it as *Tylenchus obtusus*. His description and figures indicate a typical *Pratylenchus* with plump body about 0.87 mm long and with broad head, short and strong stylet with large basal knobs, single anterior ovary and short, bluntly rounded tail.

De Man (1880) described a species of *Pratylenchus* under the name of *Tylenchus pratensis*. However, he failed to record the number of annules on the lip region, the lobe like base of the oesophagus and details of the spear, male tail and lateral fields by which the species could be determined. Systematic confusion prevailed for a very long time. Cobb (1917, 1919) described *Pratylenchus penetrans* as *Tylenchus penetrans* and *P. coffeae* as *T. musicola* and reported that these species attacked potato tubers and the roots of cotton, camphor and banana.

Zimmermann (1898) first recognized that the nematodes of this group were of great economic importance, after his discovery of Pratylenchus coffeae under the name of Tylenchus coffeae, which was found infesting coeffee roots. He was the first worker who made the demonstration of Pratylenchus pathogenicity on growing young coffee plants.

Rensch (1924) failed to recognize the proper genus for the specimens which he recovered from the roots of cereals and other plants and described them as Aphelenchus neglectus. Steiner (1927) reviewed the work of cobb & Rensch and described that Aphelenchus neglectus and Tylenchus penetrans were synonymous of Pratylenchus pratensis. In his paper he presented first photographic records of Pratylenchus inhabiting and depositing eggs in roots of lily. Steiner also emphasized that this species was a widly distributed and economically important plant parasite.

Godfreg (1929) described Pratylenchus brachyurus as Tylenchus brachyurus as the causal agent of a destructive disease of pineapples and other plants. Thorne (1934) wrote on a severe root - rot of figs produced by Anguillulina pratensis = Pratylenchus *vulnus*. Ark and Thomus (1936) recorded *A. pratensis*, probably *P. penetrans* attacking roots of apple trees.

The genus *Pratylenchus* was established by Filipjev (1934), with *P. pratensis* as type species. The first comprehensive treatment of the genus was given by Filipjev and Schuurmans Stekhoven (1941). Most of the nematologist immediately accepted the validity and convenience of this action. The revision of the genus by Sher and Allen (1953) helped a great deal to create order.

Between 1936 and 1953 numerous papers appeared on *Pratylenchus pratensis*, but in most instances the actual identity of the nematodes remains unknown. Jensen (1950) wrote a dissertation on biology and Morphology of root lesion nematodes attacking walnut roots. Allen and Jensen (1951) compared Jensen's species with specimens from sites, concluded that in all the cases only one form was involved and named it *Pratylenchus vulnus*.

All the confusion in nomenclature of *Pratylenchus* was eliminated by Sher and Allen (1953) when they compiled previous data on the genus and revised the taxonomy. They emended the diagnosis of previously described seven species and added three new species to the genus. Since 1953 *Pratylenchus* has attracted the attention of numerous workers and many observations have been published on distribution, hosts, biology and control measure of this genus.

Das (1960) was the first nematologist to describe two species of the genus *Pratylenchus*, *P. brevicercus* and *P. indicus* from India. Edward *et al.* (1969) recorded *P. crysanthus* from the roots of *chrysanthemum* sp. *Pratylenchus moolchandi* was described by Nand Kumar and Khera (1970) from the soil around the roots of *Pennisetum typhoides*. Rashid (1974) reported *P. typicus* from spinach field at Lucknow. Khan and Singh (1975) added five new species of *Pratylenchus* viz. *P. ranjani*, *P. similis*, *P. impar*, *P. neocapitatus* and *P. teres*. Das and Sultan (1979) described *P. Singhi*, *P. barkati*; *P. exilis*, *P. crassi* and *P. capitatus* from vegetable crops of Hyderabad. Later on several other species were reported by many workers from India viz. *P. nizamabadensis*, Maharaja and Das (1981), *P. manohari* Quaraishi (1982); *P. loofi* Singh and Jain (1984); *P. sasseri* Singh and Upadhyay (1987).

<u>Pratylenchus</u> <u>thornensis</u> n.sp.

(Plate 19 Fig.40,41; Plate 20 Fig.42,43; Plate 21 Fig.44,45)

Twelve Females (Paratype)

L	=	0.591 (0.400 - 0.593)mm ;	a	=	19.49 (13.30 - 24.70)
b_1	=	10.29 (6.54 - 14.40) ;	b	=	6.08 (4.43 - 7.49)
b'	=	5.07 (3.76 - 6.00) ;	B	=	0.98 (0.76 - 1.25)
C	=	18.13 (11.10 - 30.10) ;	C'	=	2.03 (1.46 - 2.74)
G_1	=	47.49 (32.30 - 60.00) ;	V	=	73.79 (67.59 - 78.40)
V'	=	78.59 (73.40 - 82.79)			
VL/VB	=	5.46 (4.08 - 8.93) ;	MB	=	50.8 (40.80 - 64.69)
O	=	35.59 (28.10 - 48.20) ;	M	=	53.0 (41.59 - 59.20)
			Spear	=	13.49 (11.17) μm.

Female (Holotype)

L	=	0.578 mm ;	a	=	24.11
b_1	=	8.11 ;	b	=	6.09
b'	=	5.29 ;	B	=	1.10
C	=	17.53 ;	C'	=	2.72
G	=	42.30 ;	V	=	78.39
V'	=	80.35 ;	MB	=	50.44
VL/VB	=	6.21 ;	M	=	50.00
O	=	48.20 ;	Spear	=	15 μm.

Three Males (Paratype)

L	= 0.47 (0.35 - 0.58)mm	; a	= 27 (21.7 - 36.6)
b_1	= 8.88 (7.00 - 11.00)	; b	= 5.57 (4.15 - 8.07)
b'	= 4.90 (4.25 - 6.02)	; B	= 0.72 (0.66 - 0.77)
C	= 20.78 (17.19 - 26.79)	; T	= 59.79 (50.79 - 58.20)
SP/L	= 0.035 (0.025 - 0.046)	; Spicule = 16.30 (15 - 17) µm.	
Spear	= 14.65 (13.00 - 17.00)	; Gubernaculum=6.89(5.32-9.00) µm.	

FEMALE CHARACTERS

(Plate 19 Fig.40; Plate 21 Fig.44,45)

The female is elongate, cylindrical vermiform, straight or slightly curved and tapering toward both extremities. Cuticle thin, superficial ornamentation consisting of moderate transverse striae and lateral longitudinal lines. Lateral field marked by four longitudinal incisures and occupy one fourth of the body width.

Lip region is relatively low, more or less feabialy rounded to flattened anteriorly, not set off from the body contour, composed of 2-3 annules, 2.5 - 4.5 µm high and 7 - 8.5 µm wide. Cephalic sclerotization well - developed, anteriorly low and arching, lateral margins posteriorly directed. Spear relatively short, massive and stout, length net exceeding 13 - 17 µm. Basal Knobs are well developed, rounded or flattened anteriorly. Metenchium is 6 - 90 µm, slightly longer than the telenchium which is 6 - 9 µm long. The Conical part of spear is much more sharply outlined than the shaft and the knobs.

The orifice of dorsal oesophageal gland is 4 - 6 µm posterior to the spear. Procorpus well defferentiated narrow, cylindrical and measuring about 17 - 34 µm in length. Median oesophageal bulb large, oval or spheroid measures 11 - 15 µm in length and 6 - 14 in width. The oesophageal lobe is elongated extending backward over the intestine measuring about 30 - 65 µm in length. The rectum is short and about 5 - 8 µm in length.

The nerve ring located about 46 - 72 µm from the anterior end of female parasite. The excretory pore present on the ventral side of the body at about 76 - 84 µm from the anterior end.

The single, monodelphic ovary which is present anteriorly directed and outstretched. The vulva is transverse slit like with two lips. The vagina is about 5 - 10 µm long extending one third of the vulval body width. The spermatheca is oval in shape and filled with round sperms. The post uterine sac is slightly longer than tail, and it measures about 55 µm long. The oocytes are arranged in a single row in the germination zone. The distance between valva and anus is more than three times longer than tail length.

The tail is short cylindrical tapering to a rounded terminus measuring about 12 - 28 µm in length. It has about 18 - 30 annules.

MALE CHARACTERS

(Plate 19 Fig.41; Plate 20 Fig.22,43)

The males are similar in shape to the females, except in tail which is concoid in male. The spicules paired, not joined, slightly arcuate about 15 - 16 µm in length, resting on thin trough like gubernaculum. Bursa envelops the tail. The testis is single, anteriorly directed and outstretched.

Habitat

Parasites were procured from the rhizosphere of papaya (*Carica papaya* L.).

Locality

Civil lines, Rewa.

DISCUSSION

According to the key presented by Loof 1978 although, the new species comes close to *Pratylenchus coffeae* (Zimmermann, 1898) Filipjev and Schuurmans Stekhoven, 1941; *P. pseudopratensis* Seinhorst, 1968; *P. vulnus* Allen & Jensen 1951 and *P. loofi* Singh & Jain 1984, but this form can be differentiated from *P. coffeae* in having smaller body, lower value of 'a', slightly larger value of 'c' slightly lower value of 'v' and posterior uterine branch is longer than vulva body diameter. In *P. coffeae* the body length measures 0.45 - 0.70 mm; a = 25 - 35; C = 17 - 22 and V = 76 - 83.

The present species closely related to the *P. pseudoparatensis* but differs in having slightly longer body length and higher value of ratio of 'c' in the case of female, whereas in case of male species it differs in possessing longer body size, higher value of 'a' and having large number of annules on the tail. The female of *P. Pseudopratensis* have the body length

0.41 - 0.50 mm, C = 21 - 26 and the body length of the male is 0.35 - 0.44; a = 26 - 30 and the number of tail annules are 12 - 19.

This worm can be very easily distinguished from *P. loofi* in having shorter body length and slightly higher value of 'b' and 'c'. The four incisures are found in the lateral in the case of *P. thornensis* whereas seven incisures are found in *P. loofi*. Three lip annules are presented in *P. loofi* but in the present form there are only two annules present on the lip region. The tail of new form is shorter than the *P. loofi*. The previous records shows that the body length of *P. loofi* is 0.59 (0.53 - 0.71) mm, value of b = 6.0 (5.0 - 6.8); C = 20.1 (15.6 - 25.7), and the tail = 28.8 (24.0 - 35.0) µm.

The present form differs from *P. vulnus* in having shorter body length. The body length of *P. vulnus* is 0.46 - 0.91 mm., whereas new form have body length 0.40 - 0.59 mm. It also differs in possessing lower value of 'a', lower value of 'v', lesser number of lip annules and longer post uterine branch. In the case of *P. vulnus* the value of a = 25 - 39, V= 78 - 82, and the number of lip annules are 4 - 5.

The above differences, therefore, indicates that the species is a new to science and named as *Pratylenchus thornensis*. It has been named in the honour of Professor GERALD THORNE, Prof. of plant pathology and Zoology, University of Wisconsin.

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PLATE 19

Explanation of figures

Pratylenchus thornensis n.sp.

Fig. 40 Entire body of female.

Fig. 41 Entire body of male.

PLATE 19

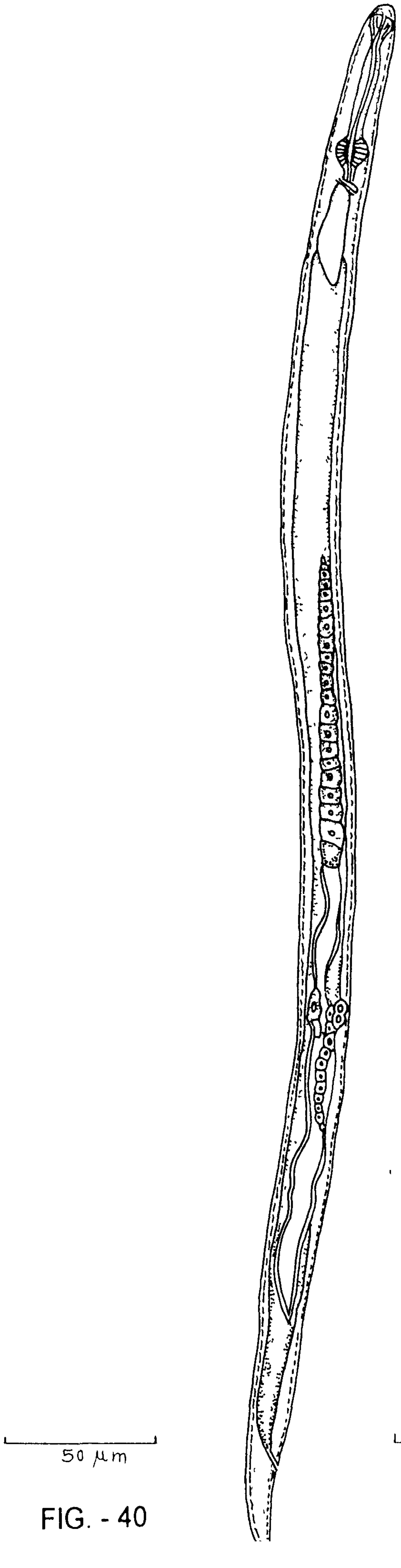


FIG. - 40

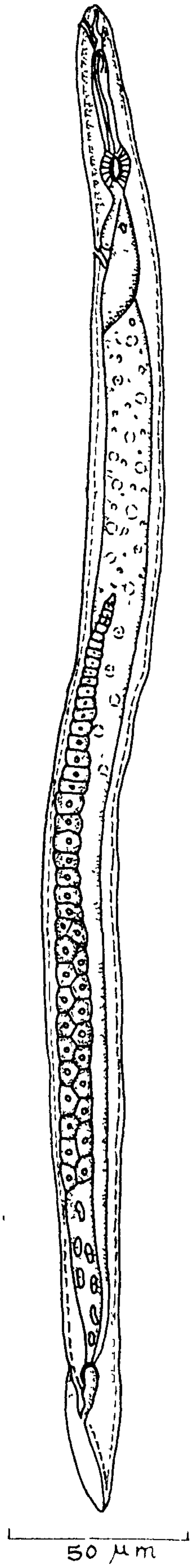


FIG. - 41

PLATE 20

Explanation of figures

Pratylenchus thornensis n.sp.

Fig. 42 Anterior region of male.

Fig. 43 Tail region of male.

PLATE 20

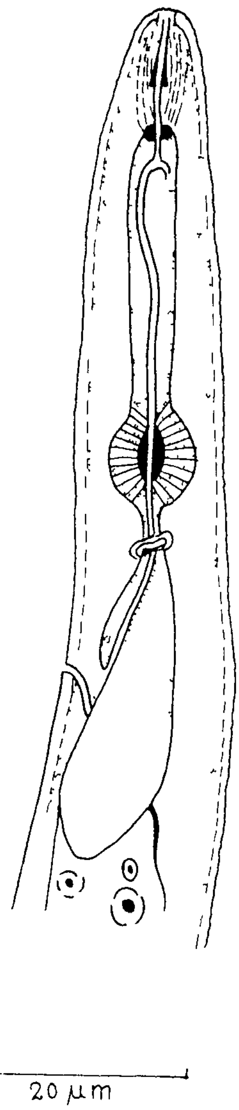


FIG - 42

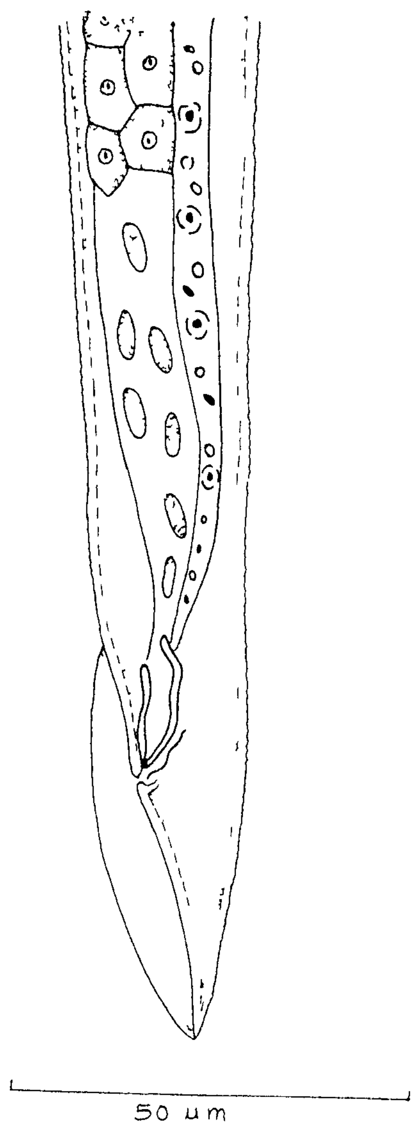


FIG - 43

PLATE 21

Explanation of figures

Pratylenchus thornensis n.sp.

Fig. 44 Anterior region of female.

Fig. 45 Tail region of female.

PLATE 21

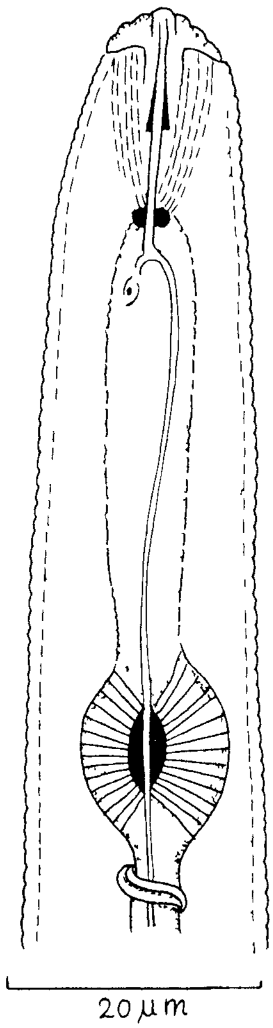


FIG - 44

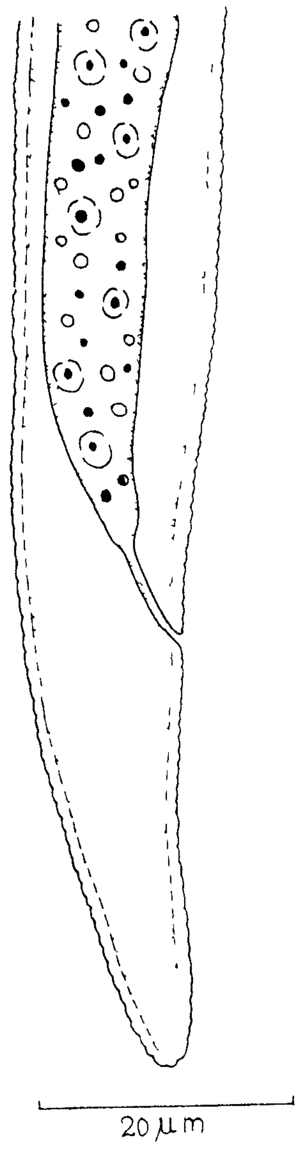


FIG - 45

CHAPTER XII

Hoplolaimus indicus Sher, 1963

HOPLOLAIMUS Daday, 1905

The genus Hoplolaimus was erected by Van Daday 1905 for the species Hoplolaimus tylenchiformis, Cobb described this genus under the name of Nemonchus. Menzed (1917) proposed the genera Iota Cobb, 1913, Criconema Hofmanner and Menzel, 1914 and ogma Southern, 1914 as synonyms of genus Hoplolaimus. In 1923 Cobb emended the genus Hoplolaimus Daday 1905 and redescribed as coarsely annulated typical tylenchid with straight larger body, prominently set off lobed lip region composed of several annules. Male having lobed bursa encompassing tail. He clearly indicated that a number of species, placed in this genus, did not belong to Hoplalaimus.

In 1949, Thorne emended the diagnosis of the genus Hoplolaimus mentioning the following characters: The cuticle of lip region divided into minute blocks by transverse and longitudinal striations, basal portion of oesophagus lobe-like well developed spear with strong knobs, massive cephalic frame-work, female tail shorter than anal body diameters.

Goodey (1957) redescribed and separated the genus Hoplolaimus (lance nematode) from Rotylenchus (spiral nematodes) on the basis of the larger size of body, offset lip region, and peculiar cephalic framework. Thorne's emendment on the basis of the cuticle of the lip region divided into minute plates did not hold up after Goodey's description of *H. proporicus*, in which only basal annule is so divided. He also recognized the lateral titillae on the male gubernaculum of some value in generic separation.

In 1958 Loof and Oostenbrink studied de Man's original collection and concluded that *Tylenchus robustus* is the same as *Hoplolaimus uniformis*. Andrassy (1958) revising the genera of *Hoplolaiminae* on the basis of the position and size of phasmids. He considered large, scutellum like phasmids one in posterior part of body and one in anterior part. The characteristics of lip region and the cephalic framework appear most valuable for generic separation. The cross striae of lateral field appears too variable to stand up as a generic character.

Luc (1958) described *H. seinhorsti* and in 1959 White head described *H. angustalatus*. These two species are somewhat similar to *H. proporicus* but *H. angustatalus* can apparently be separated on the basis of narrow lateral field present one differences in the cuticular marking of the lip region. Androssy synoymized Cobb's H.coronatus with Daday's Htylenchifornis after careful examination and comparision of both specimens. Some of the leading American nematologists do not accept this synonymy. Once again closer examination is needed to settle the question.

Sher (1961) diagnosed the genus and listed five valid species. In 1963 he again presented fresh diagnosis and gave a key of eight species. Later on Jairajpuri and Bagri (1973) recorded a key of identification of fifteen species of Hoplolaimus. Shamsi (1979) proposed a genus Basirolaimus for the species of Hoplolaimus having six nuclei in the esophageal gland lobe. Luc (1981) rejected genus Basirolaimus considering that the number of oesophageal gland nuclei is not considered a unique generic character. Robbins (1982) supported the view of Luc.

Several species of Hoplolaimus have been described from India. Kannan (1961) describe H.steineri from Madras, Sher (1963) reported H.indicus from the soil around the roots of sugarcane (Saccharum officinarum). Suryawanshi (1971) reported H.Sheri from the rhizosphere of Cynodon dactylon. Jairajpuri and Bagri

(1973) described. H.chambus from the soil around the roots of banana and sugarcane. H.obelmoschus was recorded from the roots of ladyfinger by Tandon and Singh (1973). Mulk and Jairajpuri (1976) described H.seshadrii from the rhizosphere of Archis hypogaea, H.singhi reported from Hyderabad by a Das and Shivaswany (1977). Chaturvedi and Khera (1979) described H.dubius associated with Jute crop. Shasmi (1979) described a new species of Hoplolaimus as Basirolaimus sacchari from the rhizosphere of papaver somnifermus.

Several common plants like maize, croton, ladyfinger, onion, cabbage and bringal were found mostly infected with Hoplolaimus indicus. These worms were obtained in the epidermis of the roots of ladyfinger and in soil around the roots of other plants.

Hoplolaimus indicus Sher, 1963

(Plate 22 Fig.46; Plate 23 Fig.47,48; Plate 24 Fig.49,50,51,52)

Thirteen Female (Paratype)

L	= 1.25 (1.25-1.38) mm	a	= 22.55 (18.25-25.55)
b'	= 8.18 (5.32-11.42)	b	= 10.22 (6.75-12.50)
b_1	= 12.81 (10.65-14.21)	B	= 0.95 (0.95-1.00)
G_1	= 23.59 (18.74-31.25)	G_2	= 24.15 (15.60-28.80)
C	= 51.94 (37.65-62.52)	C'	= 0.75 (0.68-0.85)
V	= 55.68 (55.00-56.95)	V'	= 56.85 (56.28-56.83)
VL/VB	= 9.87 - 12.00	m	= 48.95 (43.32-55.15)
MB	= 53.25 (43.73-66.00)	Spear	= 34.02 (33.00-35.00) µm

Female (Holotype)

L	= 1.25 mm	a	= 21.68
b'	= 5.54	b	= 6.75
b_1	= 10.85	B	= 1.00
G_1	= 31.55	G_2	= 28.15
C	= 37.65	C'	= 0.85
V	= 55.66	V'	= 55.65
VL/VB	= 9.35	m	= 43.32
MB	= 50.00	Spear	= 34.2 µm

Five Males (Paratype)

L = 1.32 (1.15-1.15)mm	;	a = 26.35 (21.45-31.35)
b = 9.75 (0.45-13.05)	;	b = 10.85 (7.45-14.35)
b_1 = 16.85 (13.65-20.28)	;	B = 1.00 (1.00-1.00)
C = 73.50 (42.00-105.00)	;	C = 1.02 (0.74-1.32)
MB = 55.75 (47.23-64.35)	;	T = 35.10 (34.00-36.00)
Sp/L= 0.025 (0.017-0.029)	;	Spicules = 32.00(30.00-34.00)
Gubernaculum = 19.00 (18.00-20.00)μm.	;	Spear = 30.50 (29.00-32.00)μm

FEMALE CHARACTERS

(Plate 22 Fig.46 Plate 24 Fig.49, 50, 51, 52)

The shape of body is Ventrally arcuate, more or less spindle like when fixed in hot water. It tapers towards both extermities. Body 1.25 (1.25-1.38)μm long and 58.00 (45.00-70.00) μm wide. Cuticle is transversely striated and the striae being 2.5-2.8 μm apart at mid body. The normal lateral fields marked by single incisure which is distinct in the tail region only. In some specimen three more weakly marked and incomplete incisures were found to be present in lateral field at mid body.

The lip region is distinctly set-off, hemispherical marked with 3-4 annules and measures about 13-15 μm in length and 6-7 μm in breath. The cophalic frame work is more massive and yellowish in appearance. The spear is strongly built. Metenchium is 17-20μ long. The spear knob's are best observed in living specimens. They are furnished with 2-3 anterioly projecting processes and measuring 5-7 μm long and 5μm in breadth. The distance of orifice of dorsal esophogeal gland from spear base is 5-8 μm.

The procorbus is narrow . measures 39.00 (35.00-43.00) in length. Median oesophageal bulb appears typically oval measuring 18-20 μm in length and 15-18 μm breadth located 100.45 (90.00-120.00) μm from anterior end with well developed crescentric value in the centre. The oesophageal gland lobe 88.00 (70.00-120.00) μm long. It overlaps the anterior part of intestine dorsally and laterally, situated 200.00 (160.00-240.00) μm from the anterior end with six nuclei. Oesophago-intestinal valve is well developed. The intestine covers the whole of the space of the body and is packed with large granules. It overlaps the rectum beyond the level of the anus.

The nerve ring surrounds the isthums below the median oesophageal bulb. It is placed at about 101

(92-110) μm from the anterior end. The excretory system has not been thoughly studied although the excretory pore opens ventrally in the region of nerve ring or infront of oesophago-intestinal junction or anywhere between these two position. It is located 120 (115-135) μm from the anterior end.

Hemizonid usually present 4-7 annules posterior to excretory pore. Anterior phasmid is 30-35 μm anterior end of the body and posterior phasmid is 78-82 μm from anterior end of the body. The rectum is short tube 19.00 (15.00-26.00) μm long.

There are two ovaries which are out streched. The vulva is a transverse slit like aperture, located 705.00 (675.00-725.00) μm from anterior end, the outer margins of which may not have small lateral flaps. It leads in to short vagina which is placed at 18.26 (18.00-22.00) μm distance. The epiptygma is present in one specimen and attached posteriorly. Spermathecae are present at the junction of the ovary with oviduct, these are usually obscured by intestine.

The tail is short about 20.8 (15-25) μm long and bears 8-12 tail annules. The tail terminus is rounded and annulated.

MALE CHARACTERS

(Plate 23 Fig. 47, 48)

Male is similar to female in general body shape and morphology except for sexual dimorphism. The head is broadly rounded with 2-3 annules. The hemizoind is 3-4 annules wide and 4 annules posterior to excretory proe.

Testis is single. Two spicules are present, which are tylenchoid in shape and of equal in length. They measure 32.00 (30.00-34.00) μm in length. The gubernaculum is well developed which measures 19 (18.00-20.00) μm in length and has characteristic shape of the genus.

The tail of male specimen enveloped by crenated bursa with the phasmid. It is small 20.32 (12.30-29.33) μm in length.

Habitat - Collected from the soil around the root of bean (Dolichos lablab).

Locality - Agriculture College Campus Rewa.

DISCUSSION

This species was originally described by Sher 1963 from the soil around the roots of sugarcane in Karnal India. The specimens collected by the author closely related with the description of the species as given by Sher 1963. Although these species are quite similar in many respects but, the closer and critical examination reveals that there are certain differences in discription and illustration. Sher described three annules in the holotype in the lip region whereas his diagram shows four annules. In the present collection of the author the number of lip annules varies from 3-4.

The position of hemizonid and excretory pore in relation to oesophago-intesinal junction is apparently variable. Sher laid considerable emphasis on the position of hemizoind and excretory pore. The value of "o" distance from stylet knobs to opening of dorsal gland expressed as a percent of stylet length is a character quite valuable in separating species. The value of "o" of present specimen is also some what larger rather than the given by Sher.

The epiptygma is usually absent in this population, if present it is normally attached posteriorly. Considering the subsequent observations by

Banerji and Banerji (1966), Gupta and Gupta (1967), Husain and Rashid (1969), Dasgupta _et al_. (1970), Khan and Chawla (1975) and Chawla and Yadava (1981 a and 1981 b) these differential characters are regarded as intraspecific variations.

Hoplolaimus indicus is reported only from India where it is widely distributed (Sitaramaiah _et al_. 1971, Khan and Chawala, 1975). It is polyphagus plant parasite which mainly feeds on various roots, thus effecting the growth of plant and yield.

It is highly pathogemic to rice (Das and Rao 1970; Rao 1970); Sugarcane (Singh and Misra, 1976), Maize (Haider _et al_. 1978), Citrus (Lenman, 1981) and cotton (Gaur and Mishra, 1981) and is capable of causing stunted and patchy growth of these plants. It is also responsible for the failure of a number of crops in west Bengal (Banerji and Banerji, 1966).

PLATE 22

Explanation of figure

Hoplolaimus indicus Sher, 1963

Fig. 46 Entire body of female.

PLATE 22

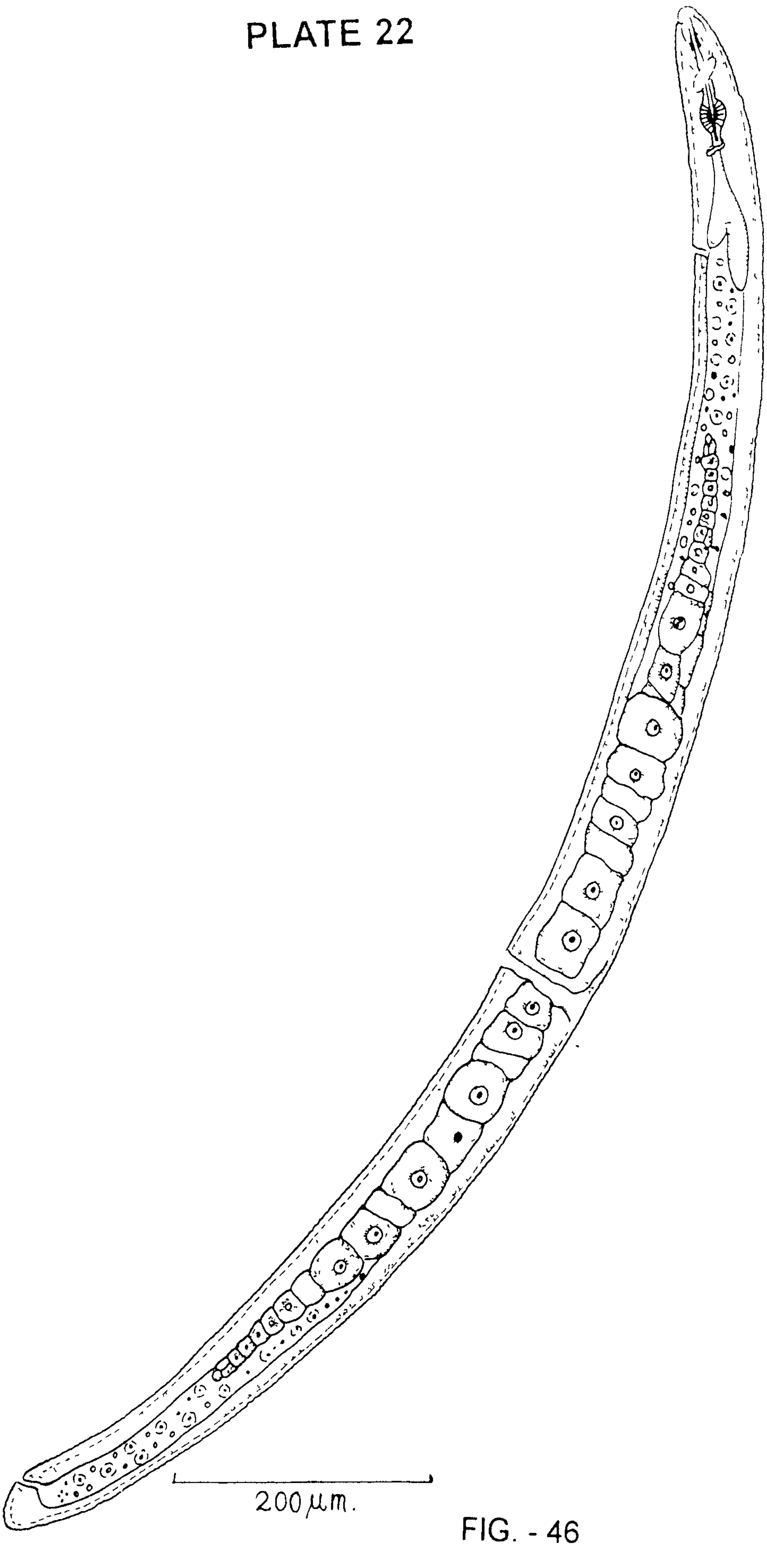


FIG. - 46

PLATE 23

Explanation of figures

Hoplolaimus indicus Sher, 1963

Fig. 47 Tail region of male.

Fig. 48 Anterior region of male.

PLATE 23

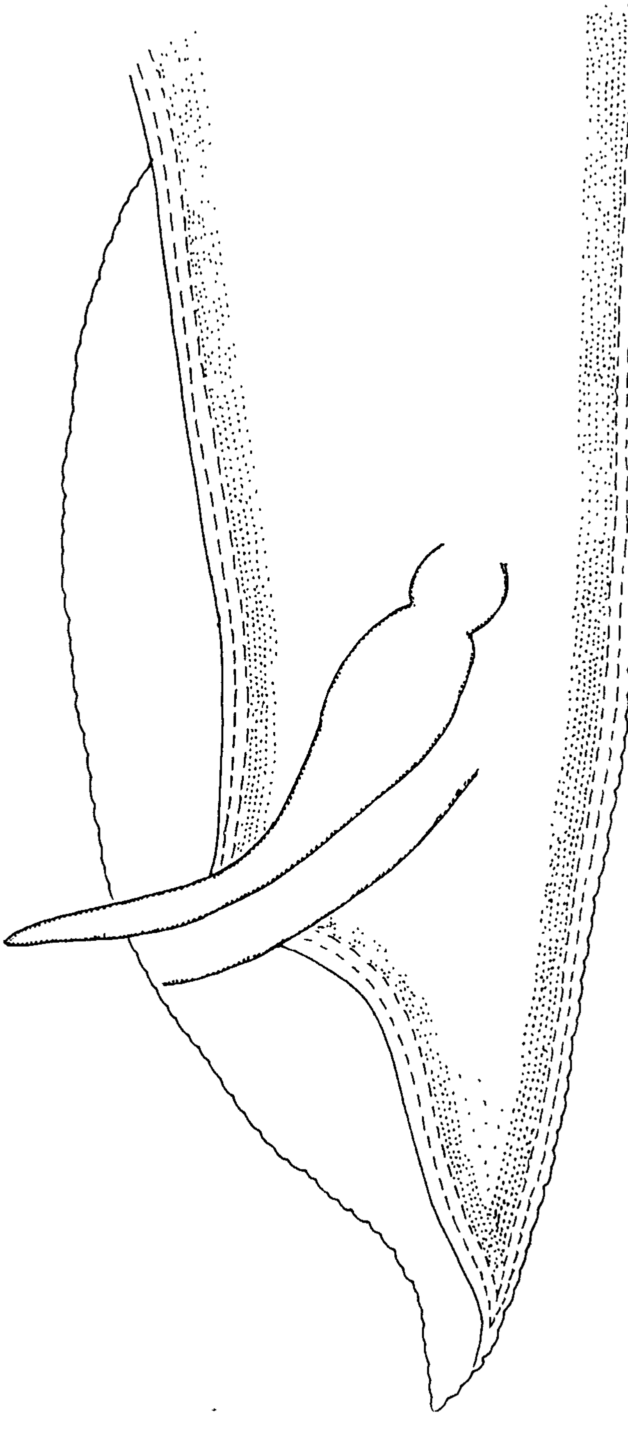


FIG. - 47

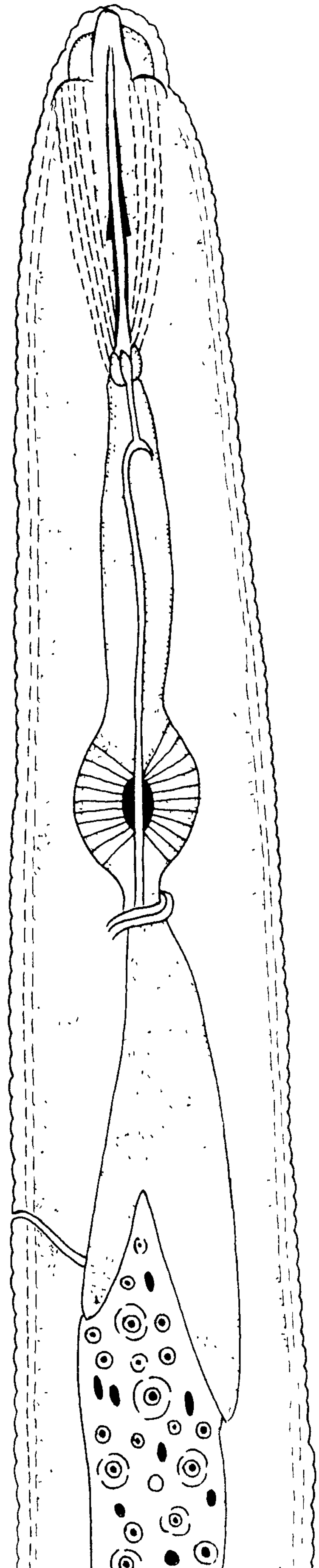


FIG. - 48

PLATE 24

Explanation of figures

Hoplolaimus indicus Sher, 1963

Fig. 49 Tail region of female showing phasmid.

Fig. 50 Anterior region of female.

Fig. 51 Lateral line incisures.

Fig. 52 Tail region of female.

PLATE 24

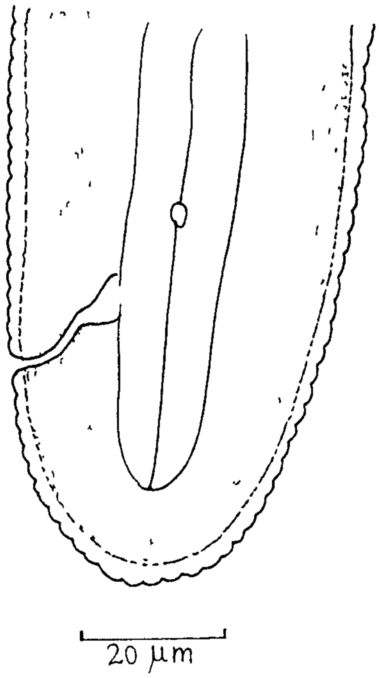


FIG. - 49

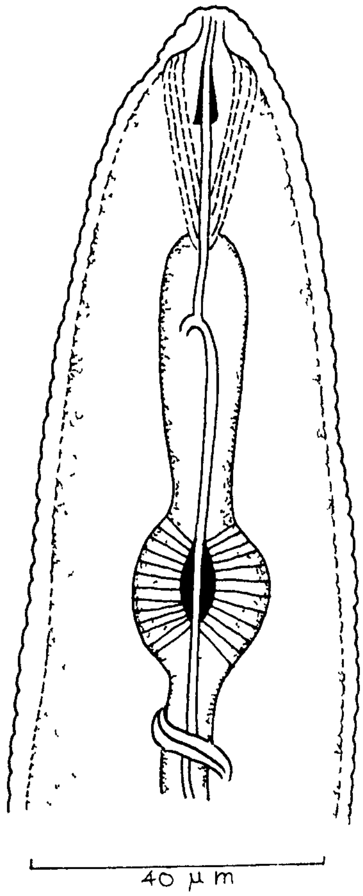
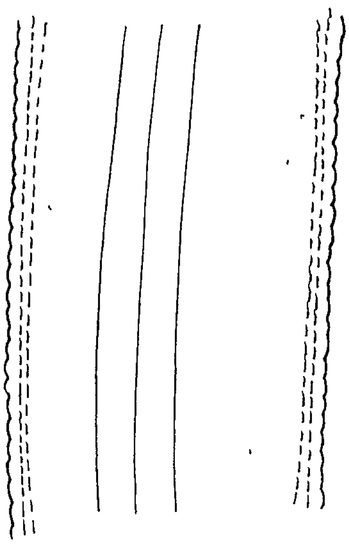
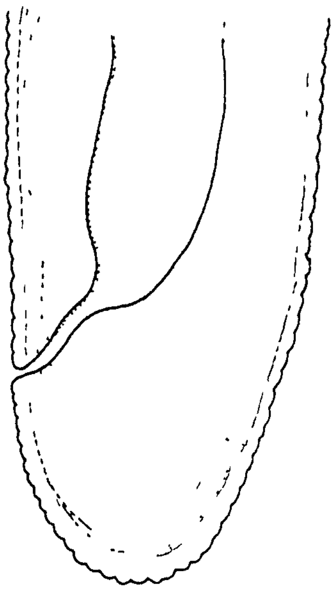


FIG. - 50





20 μm

FIG - 51.

FIG - 52

CHAPTER XIII

Helicotylenchus jenkinsis n.sp.

<u>HELICOTYLENCHUS</u> Steiner, 1945

The genus <u>Helicotylenchus</u> was erected by Steiner in 1945 for <u>H.nannus</u> as a type species. The genus contains the most common, abundant and widely distributed spiral nematodes. These are either ectoparasitic, semiendoparasitic or endoparasitic (Parry <u>et</u> <u>al</u>. 1959, Ruchle, 1975; Jones, 1978). Many species damage the cortex of host roots causing necrosis. Golden (1956) revised the genus <u>Helicotylenchus</u>. Steiner (1945) separated the genus <u>Helicotylenchus</u> from <u>Rotylenchus</u> on the basis of type of basal esophageal bulb and the position of the phasmid which is anterior in <u>Helicotylenchus</u> and posterior in <u>Rotylenchus</u> to the level of the anal opening.

Golden separated the two genera on the basis of position of the phasmid and dorsal gland outlet. He concluded that if the phasmids were pre-anal and the dorsal gland outlet more than one third the length of the stylet posterior to the stylet knobs, then the specimens belonged in <u>Helicotylenchus</u>.

Andrassy (1958) revised the genera of subfamily. Hoplolaiminae and separated into two groups:

the first with phasmids small pore like - Rotylenchus and the second with phasmids large, scutellum like - Hoplolaimus. In the first group he placed Helicotylenchus with six species. Then Helicotylenchus was separated on the basis of the distance between the spear knobs and dorsal gland outlet being more than one third the length of the stylet. He placed two species R.melancholicus Lordello, 1955 and R.iperoiguensis Carvalho, 1956 in Helicotylechus with this distance less than one third the stylet length. Perry et al. (1959) described four new species of spiral nematodes and synonymized Gottholdsteineria with Helicotylenchus and recognized twelve species of Helicotylenchus.

Rotylenchus can easily be separated from Helicotylenchus on characters of the lip region. The lip regions of Helicotylenchus are continuous with body contour and cupolate. The species of Helicotylenchus can be also separated on the degree to which they from spiral shape and significant difference in musculature.

Sher (1966) considered that the genus Helicotylenchus is quite different from the genera Hoplolaimus, Aerolaimus Scutellonema, Peltamigratus and Rotylenchus because of unique morphological structure of oesophageal glands, which is in this genus often seen as three lobes overlaping the intestine dorsally, laterally and ventrally with the longest development usually on the ventral side. He pointed out that *Rotylenchoides* was most closely related to *Helicotylenchus* on the basis of structure of oesophageal glands and other similarities in general morphology. Overlaping oesophagus is a common character in different species of *Helicotylenchus*.

Goodey (1951) synonymized *Helicotylenchus* with *Rotylenchus* without any comment. But again due to the position of dorsal oesophageal gland orifice he included three species in this genus. In 1966 the genus was revised by Sher. He established the criteria upon which the taxa within this group are recognised. In the genus *Helicotylenchus* Sher (1966) listed thirtyxis new species and redescribed eighteen known and valip species. Ten new species of *Helicotylenchus* proposed by Roman (1965) were not included in Sher's revision.

Siddiqi (1972) listed sixtynine new species in this genus and described a key of fortynine species, based on female and male characters. Anderson (1978) recommended the farmula of Siddiqi for the description of new species. The frequency with which new species have been reported from every continent of the world, indicates the world wide distribution of this genus.

Helicotylenchus sp. are most probably very commonly found as plant parasitic nematodes. In India the first species of *Helicotylenchus* was described by Das (1960) as *H.crenatus*. Later on Siddiqi (1972) reported sixtynine species and Jain *et al*. (1986) described two new species *H.saccharumi* and *H.sheri* from the soil around the roots of sugarcane and bryophyllum respectively from Uttar Pradesh. After this several species of this genus have been added from different parts of India.

<u>*Helicotylenchus jenkinsis*</u> n.sp.

(Plate 25 Fig.53; Plate 26 Fig.54; Plate 27 Fig.55,56)

Thirteen Females (Paratype)

L	= 0.639 (0.563-0.74) mm.	;	a	=	24.91(18.81-29.21)
b_1	= 11.12 (7.53-19.15)	;	b	=	5.99(4.23-8.13)
b'	= 5.59 (4.59-8.13)	;	B	=	0.82(0.63-1.08)
G_1	= 35.70 (28.70-3.75)	;	G_2	=	15.81(3.21-22.51)
C	= 1.85 (26.85-56.76)	;	C'	=	1.06(0.81-1.88)
V	= 63.54 (55.60-69.30)	;	V'	=	66.30(63.50-68.10)
VL/VB	= 7.68 (5.83-9.23)	;	m	=	46.10(35.00-53.60)
O	= 19.00 (14.55-25.00)		Spear	=	24.00(20.00-27.00) µm

Female (Holotype)

L	= 0.654 mm.	;	a	=	28.35
b_1	= 9.88	;	b	=	6.93
b'	= 6.46	;	B	=	0.65
G_1	= 44.25	;	G_2	=	17.32
C	= 44.40	;	C'	=	1.00
V	= 54.20	;	V'	=	66.07
VL/VB	= 9.14	;	m	=	50.00
O	= 19.20	;	Spear	=	26.004µm.

FEMALE CHARACTERS

(Plate 25 Fig. 53 Plate 26 Fig.54 Plate 27 Fig.55,56)

The body shape of female worms usually forming an open spiral or more or less spindle shape. The cuticle is transversly striated. Lateral fields marks by four incisures, which usually units at the posterior half of tail regions.

Lip region annulated, having four to six annules, which are not prominent enough, hemispharical and continuous. They are 5-10 μm wide and 3-5 μm high. The cephalic frame work is well sclerotized, and appears as conspicuous arch in lateral view. The stylets are strong and long with rounded basal knobs. It measures 20-26 μm in length.

The position of orifice of dorsal oesophageal gland is conspicuous and it is situated 3.45 (2.00-5.00) μm from the spear base. The median oesophageal bulb typically spheroid. The procorpus is cylindrical and measures 33.3 (24.00-53.00) μm in length. The oesophageal gland lobes overlap the intestine from dorsal and ventral side and measures 50(4-60) μm in length.

The excretory pore situated anterior to the oesophageo-intestinal junction. The nerve ring is placed 75.5 (40.00-112.00) μm from the anterior end.

The genital tract is didelphic. The posterior branch is slightly shorter than anterior one. The valva is a transverse slit like. The ovaries are two and outstretched. The oocytes in a single file. Uterus contains one egg and two larvae. The spermatheca is spherical and have sperms in it. The vagina measures 13.15 (9.00-18.00) μm in length.

The tail dorsally convex conoid and measuring about 15.40 (14.00-19.00) μm in length, with 6-12 annules near the tip. The phasmids are distinct and have 5-10 annules anterior to the anal level.

MALE : Not found.

Habitat :

Helicotylenchus was first collected from the roots of Doop grass (Cynodon dactylon Pers). Later on it was found associated with the roots of number of different species of plants.

Locality : Chirahula Colony, Rewa.

DISCUSSION

About twelve species of genus *Helicotylenchus* ei. *H.nannus* Steiner, 1945; *H.degonicus* Perry, 1959; *H.platycerus* Perry, 1959; *H.microlobus*, Perry, 1959; *H.pumilus* Perry, 1959; *H.buvephilus* Golden, 1956; *H.multicinctus*; *H.erythrinae*; *H.melancholius*; *H.quarta*; *H.goodegi*; *H.iperoiguensis* has been reported from various places of world.

According to the key of Fotedar and Kaul (1965) the present new species closely related to *Helicotylenchus bradys*. Thorne and Malek 1968, *H.exallus* Sher 1966 and *H.macronatus* Mulk Jairajpuria, 1974.

It differs from *H.bradyas* in having shorter length of spear. The length of spear of new species is 26.00μm. Where as *H.bradys*, it is 29-33 μm. It also have shorter dorsal oesophageal gland out-let behind the knobs. In the case of *H.bradys* dorsal oesophageal gland out-let measures 9 μm. The closer examination shows that these two species are also somewhat differs in presence of number of sperms.

In the comparison of new species with *H.macronatus*, these species are quite similar in many respects but it differs from *H.macronatus* in the length of body and spear. The length of body in *H.macronatus* is

0.51-0.59 mm. Whereas the new species measures 0.652 mm. in length and the spear 20-22 µm in H.macronatus and in this species it is 26.00 µm.

The vlaue of "o" distance from stylet knobs to dorsal gland opening is quite valuable in separating species of Helicotylenchus. The value of "b" is also one of the most important factors for identification of the species of this genus. Here in these two factors, both the species deffers allot. This new species differ in having higher value of "b" and lower value of "o". In H.macronatus the value of "b" is 5.7-6.3; "o" is 40-47 and dorsal oesophageal gland out-let 8-10 µm.

From H.exallus it differs in having lower value of "a" and "o" and higher value of "v" and "b". It has shorter oesophageal gland out let behind spear. In the case of H.exallus the value of a = 26 - 32; b = 4.5-5.4; o = 32 - 44 and v = 59 - 63.

It is, therefore, concluded that the species described above is new to science. It is proposed Helicotylenchus jenkinsis in the honour of Professor W.R.Jenkins, Department of Entomology, Rutgers, The State University, New Brunswick, New Jersey.

PLATE 25

Explanation of figure

Helicotylenchus jenkinsis n.sp.

Fig. 53 Entire body of female.

PLATE 25

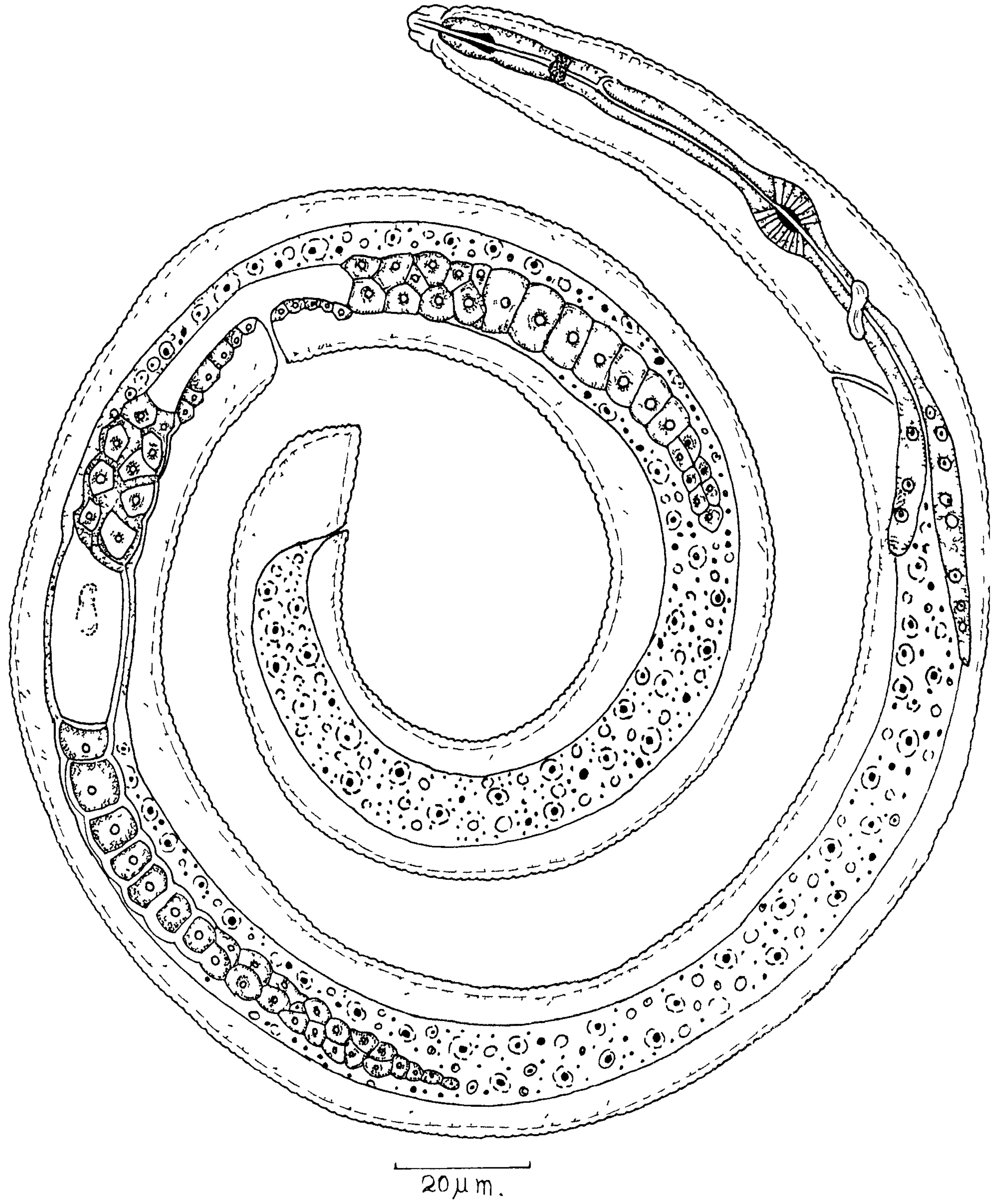


FIG - 53

PLATE 26

Explanation of figure

Helicotylenchus jenkinsis n.sp.

Fig. 54 Entire body of female showing larval forms in the uterus.

PLATE - 26

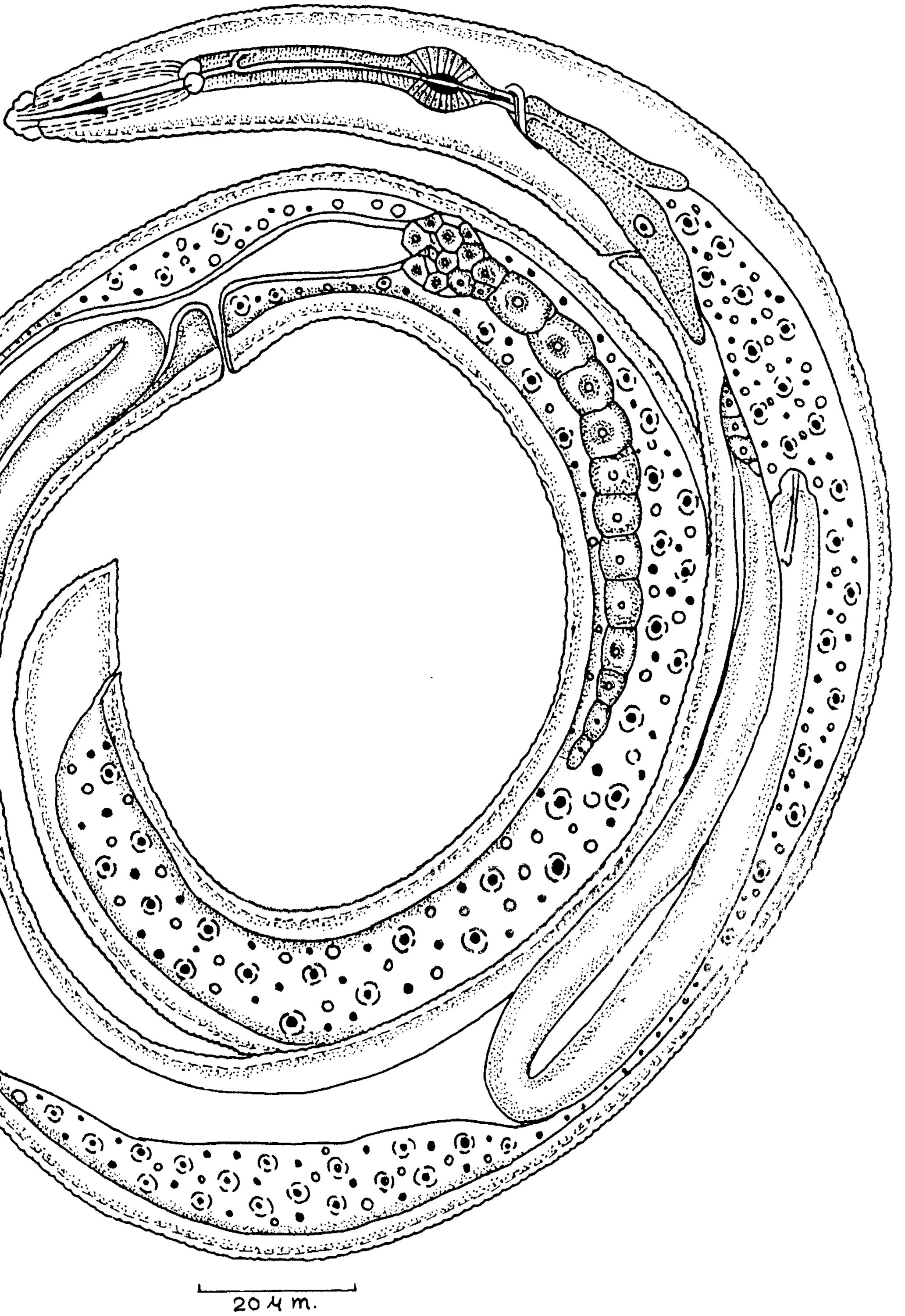


FIG. - 54

PLATE 27

Explanation of figures

Helicotylenchus jenkinsis n.sp.

Fig. 55 Anterior region of female.

Fig. 56 Tail region of female.

PLATE 27

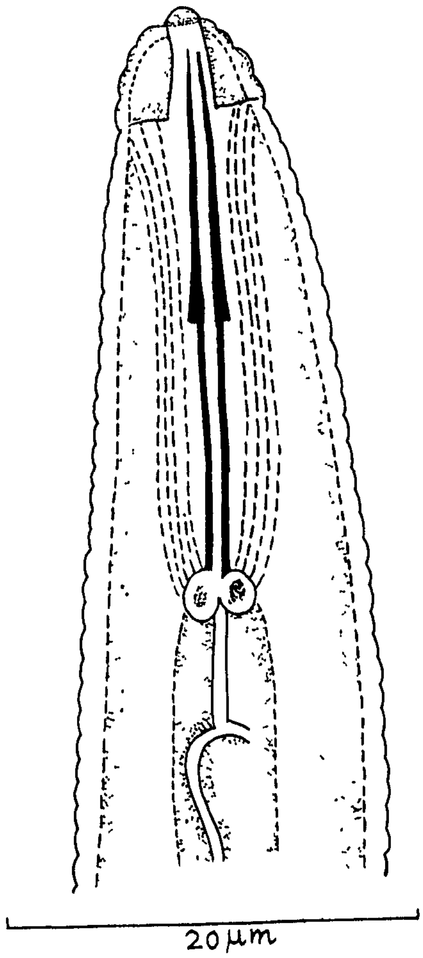


FIG. - 55

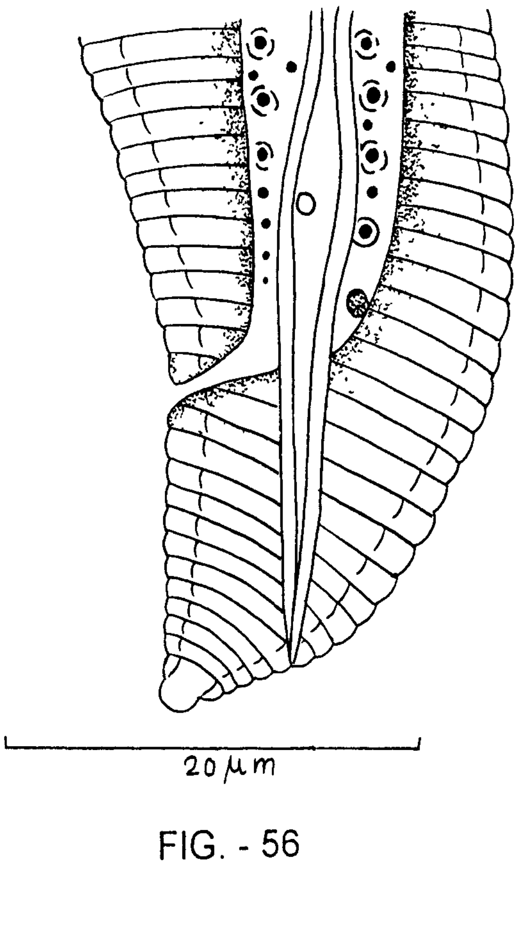


FIG. - 56

CHAPTER XIV

Seineura sasseris n.sp.

<u>SEINEURA</u> Fuchs 1931

The German worker Fuchs (1931) established the genus <u>Seineura</u> with <u>S.mali</u> as type species. Unfortunately, <u>Seineura</u> has not been accepted as a valid genus by most nematologists, and the genus was synonymized with Pathoaphelenchus Cobb, 1927 by Steiner (1931) and later with Aphelenchoides Fischer, 1894 by Goodey (1933). The diagnosis given by Fuchs was in brief but accurate and his sketches shows important diagnostic characters. These diagnostic characters gives sufficient evidence to justify full generic rank. So Goodey (1960) restablished the genus <u>Seineura</u> and listed fifteen valid species under this genus.

Linford and Oliveira (1937) made an important and interesting investigation that the members of the genus Seineura are predators on other nematodes. <u>Seineura tenuicaudatus</u> was especially responsive and proved to be highly specialized predators. It readily attack larger nematodes with inserting the spear and paralysis the prey by injecting secretion of the dorsal esophageal gland.

Christie (1939) reported a key for the *identification of nine species described at that time.*

The number has since been increased to about fifteen. Hechler and Taylor (1965) reviewed the genus and included a key for seventeen species based mainly on female characters. Since then thirteen more species has been added to, this genus. Husain and Khan (1965) described S.nagini from India. A Russian nematologist Dritrenko (1960) recorded S.chertkovi from tomato roots Khan (1965) described S.variobulbosa from the roots of winter rye.

Massay (1966 and 1971) described S.pini and S.sutura associated with insects. Siddiqi et al. (1967) added S.propora; Edward and Misra (1969), S.fuchusi; Suryawanshi (1971), S.indica; Singh, S.P. (1977), S.tandoni and S.kherai; Chaturvedi and Khera (1979), S.hechlerae and Bajaj and Bhatti (1983), S.tritica and S.clavata to the list of species reported from India.

A number of specimens of the genus Seineura were obtained from the soil around the roots of garden Croton (Codiaeum variegatum). On examination these were found to be only females, male were not procured. The roots of garden croton were also having heavy infection of Rotylenchus reniformis.

Seineura sasseris n.sp.

(Plate 28 Fig.57, 58 Plate 29 Fig.59, 60, 61
Plate 30 Fig.62, 63).

Seventeen Females (Paratype)

L	=	0.39 (0.35-0.43)mm. ;	a	=	23.21 (20.00-25.21)
b	=	7.25 (7.22-7.28) ;	bl	=	7.73 (7.57-7.88)
b'	=	4.28 (3.82-5.16) ;	B	=	0.59 (0.46-0.75)
G_1	=	20.50 (14.50-30.60) ;	G_2	=	13.61 (10.00-15.41)
C	=	9.20 (6.00-15.20) ;	C'	=	6.46 (5.58-7.80)
V	=	60.30 (57.70-63.40) ;	V'	=	72.81 (71.81-73.60)
VL/VB	=	9.82 (7.52-10.20) ;	m	=	47.0 (44.40-50.00)
PO	=	41.30 (24.70-50.50) ;	Spear	=	8.16 (7.50-9.00)μm

Female (Holotype)

L	=	0.38 mm ;	a	=	25.20
b	=	7.28 ;	bl	=	7.58
b'	=	3.82 ;	B	=	0.46
Gl	=	30.60 ;	G2	=	11.00
C	=	6.00 ;	C	=	7.80
V	=	59.80 ;	V	=	71.80
VL/VB	=	10.20 ;	m	=	50.00
PO	=	50.50 ;	Spear	=	8 μm.

One Male (Paratype)

L = 0.326 mm	;	a = 19.10	
b =6.25	;	b = 6.50	
b' = 4.43	;	C = 12.00	
B = 0.58	;	SP/L = 0.050	
T = 41.21	;	MB = 68.00	
m = 42.81	;	Gubernaculum = 7.00 μm.	
Spicule = 16.00μm	;	Spear = 7.00 μm.	

FEMALE CHARACTERS

(Plate 28 Fig.58 Plate 29 Fig.59, 60, 61
Plate 30 Fig. 63)

The body of female is moderately arcuate ventrally, cylindrical, tapering more towards the posterior end. Cuticle is finally striated and striate are one μm apart at the mid body region. Lateral field marked by three incisures and occupy one fourth of corresponding body width. Deirids and phasmids are not observed in these specimens.

Lip region is slightly offset, hemispherical with poorly developed sclerotization. It is 3.5 μm high and 5.5 μm wide. The spear is well developed, delicate and without basal swellings. Its anterior part is shorter but more refractile than the posterior one. A small quiding ring is present just anterior to the middle of the spear.

The procorpus is cylindrical about 31.00 (27.00-38.00) μm in length and 10-20μm in breadth. It has distinct valvular apparatus located at 60 percent of bulb length. The median oesophageal bulb is spherical, measures 12.00-16.00 in length and 6.50-9.00 μm in breadth. It has centrally located crescentic valve. The oesophageal gland lobes overlap intestine dorsally and measure 38.6 (21.00-50.00) in length. The lumen of intestine in wide just posterior to the median oesophageal bulb, narrowing rapidly behind the nerve ring and widening just anterior to the valve. The rectum is tubular and measure 5.00-9.00 μm in length.

Nerve ring is situated posterior to the median oesophageal bulb and approximately 58.00 (50.00-65.00) μm from the anterior end. Excretory pore opens ventrally anterior to the nerve ring at the level of posterior margin of the median oesophageal bulb. Its distance from anterior end is 63.00 (60.00 - 66.00)μm. Hemizonid is 2-3 annules wide and located about 21 μm. posterior to the median oesophageal bulb.

The genital tract is monodelphic and prodelphic valve is transverse slit like which opens into vagina. Vagina is perpendicular to the body axis, slightly anteriorly directed. It is 5.50-10.00 μm in length. Ovary is long, outstratched and extends upto the posterior margine of oesophageal gland lobes. It is separated from uterus by a constriction. Spermatheca is large oval filled with rounded sperms. The post uterine branch is shorter than vulva - anus distance.

The tail is long about 63.00 (60.00 - 67.00)μm in length and shorter than vulvar - anus distance. It tapers gradually but suddenly narrows anterior to the middle into a cylindrical flagellum with pointed terminus.

MALE CHARACTERS

(Plate 28 Fig.57 Plate 30 Fig.62)

Males are elongated cylindrical slightly shorter than females. The length of body measures about 0.326 mm. Head, oesophagus, oesophageal gland lobes, cuticle, position of nerve ring, excretory pore are similar to the female.

The testis is single and outstretched. The spicules are massive arcuate and measure about 16 μm in length. Gubernaculum is about 7.00 μm in length.

The tail of male nematode is arcuate a small ventral projection is found on the tail tip and measures 27 μm in length.

Habitat - The parasite has been collected around the rhizosphere of Bainjal (*Solanum melongena* Linn.)

Locality : Indra Nagar, Rewa.

DISCUSSION

There are seven species of genus *Seineura* in which present new from closely related to *Seineura linfordi* (Christie, 1939) Goodey, 1960; *S.indica*, *Suryawanshi* 1971; *S.varicaudatus* Singh and Jain, 1982.

The new species can be distinguished from *Seineura linfordi* in having shorter length of body. The length of body is *S.linfordi* is 470-620 μm. whereas the new species has 0.32-0.38 mm body length. It has lower value of "a" and "v" as compared to *S.linfordi*, in which "a" = 27.3 - 34.3 and V = 70.00 - 74.50. The length of spear is shorter e.i. 7.00 μm whereas in *S.linfordi* its length is 15.8 μm.

It also differs from *S.indica* Suryawanshi, 1971 in having higher value of "b", "c" and lower value of "v" and shorter spear, lateral field marked by only three incisures and presence of male. In S.indica "b" = 3.7; c = 7.5; v = 70; spear = 19µm and lateral line has five incisures.

This species resembles with S.varicaudatus in many respect but differs in having shorter body length e.i. 0.39 (0.35 - 0.44) mm whereas in S.varicaudatus the body length is 0.62 (0.57-0.71) mm. The spear of new species is 8.16 (7.50-9.00) µm whereas S.varicaudatus has spear of 17.4 (15.00-20.00) µm in length. The value of "a" and "v" in this species is 23.00 (20.00 - 25.00) and 60.30 (57.70 - 63.40) respectively. The tail of new species is longer as compared to S.varicaudatus 45.60 (40.00 - 52.00)µm. The male has been procured but in S.varicaudatus the male is unknown.

As a result of these differences the author feels justified in creating a new species for this worms and named as Seineura sasseris in honour of Professor J.N.Sasser, Department of Plant Pathology, North Carolina State College Raleigh, North Carolina.

PLATE 28

Explanation of figures

Seineura sasseris n.sp.

Fig. 57 Entire body of male.

Fig. 58 Entire body of female.

PLATE 28

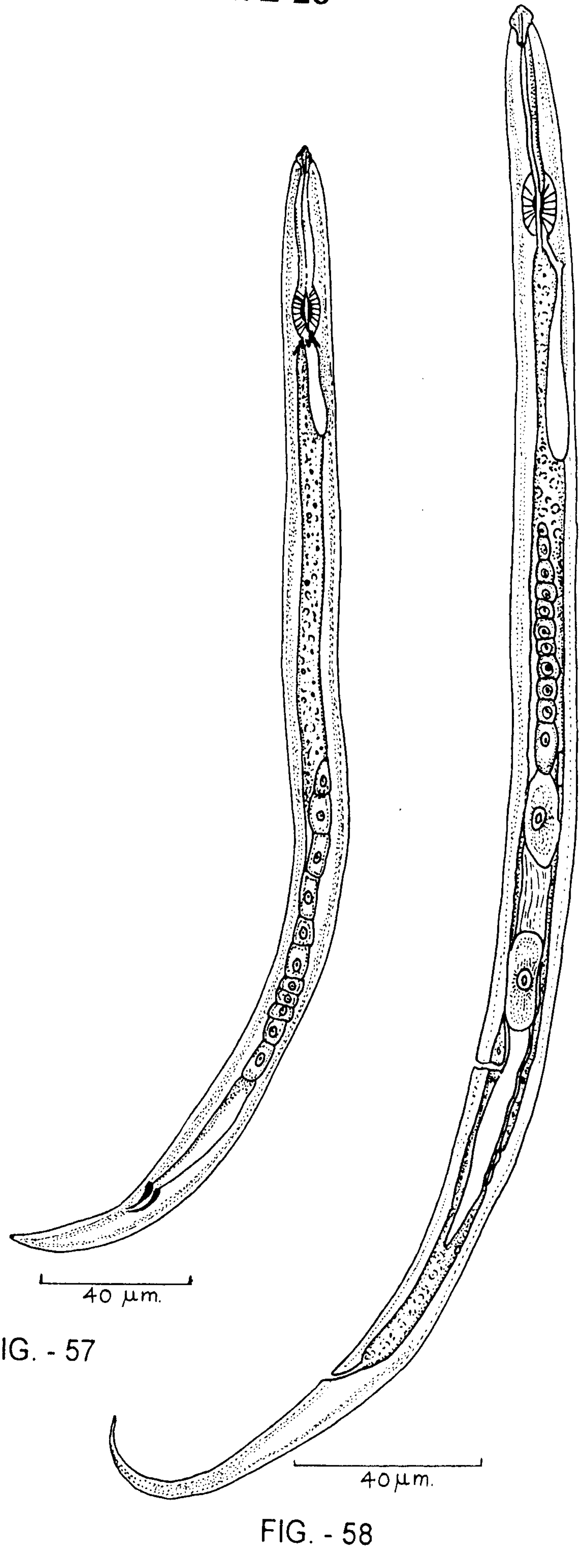


FIG. - 57

FIG. - 58

PLATE 29

Explanation of figures

Seineura sasseris n.sp.

Fig. 59 Vulval region of female

Fig. 60 Anterior region of female

Fig. 61 Lateral line incisures in the middle region of female body.

PLATE 29

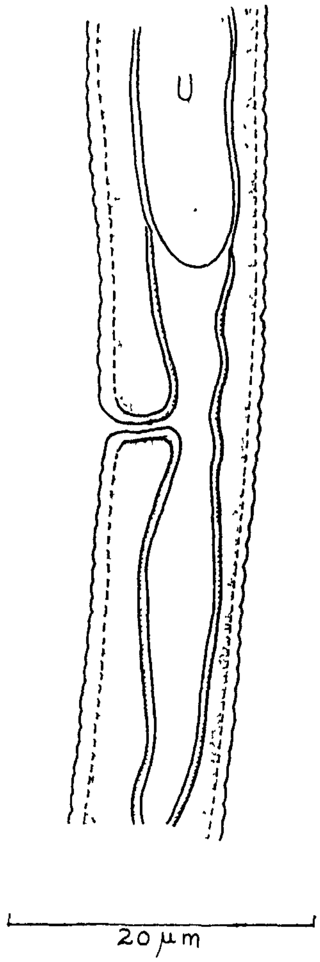


FIG. - 59

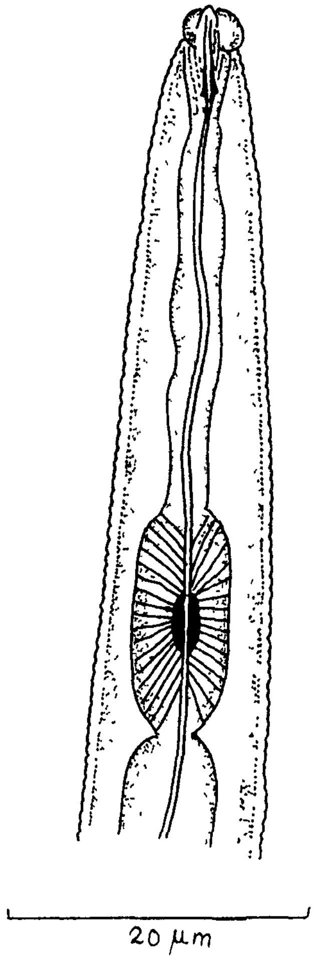


FIG. - 60

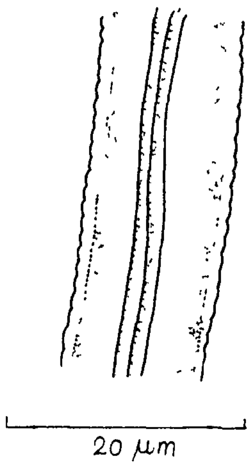


FIG. - 61

PLATE 30

Explanation of figures

Seineura sasseris n.sp.

Fig. 62 Tail region of male.

Fig. 63 *Tail region of female.*

PLATE 30

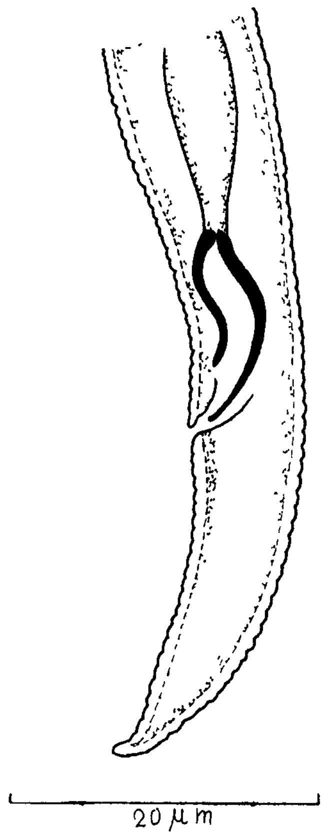


FIG. - 62

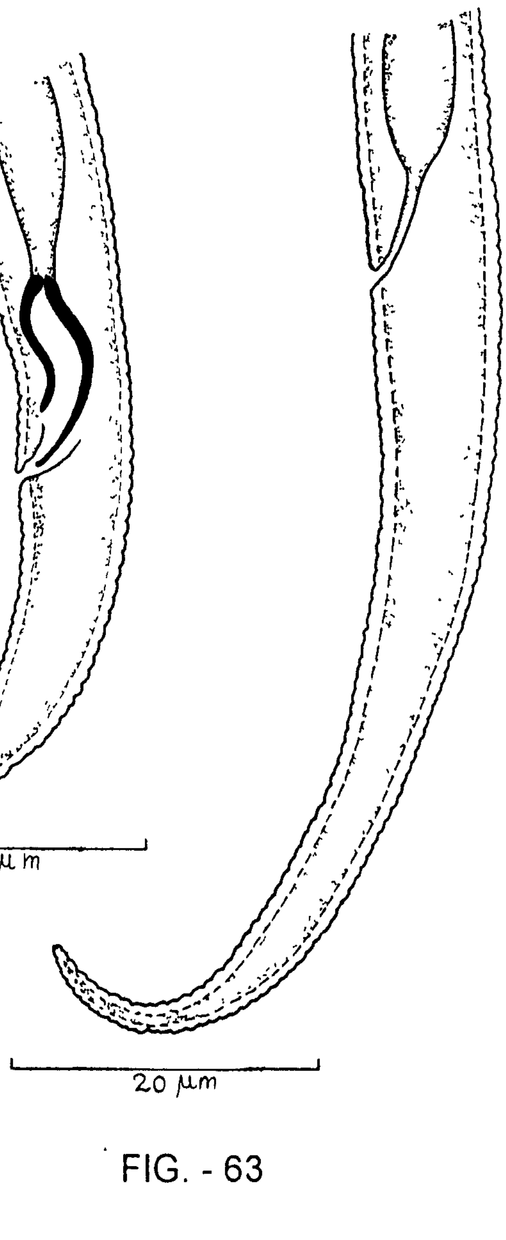


FIG. - 63

CHAPTER XV

Xiphinema basari Siddiqi, 1959

<u>XIPHINEMA</u> Cobb, 1913

The genus Xiphinema was proposed by Cobb (1913) with <u>Xiphinema</u> <u>americanum</u> as its type species and stated that the species was among those injurious to vegitation. He recorded its infection in the roots of a variety of plants Corn, grass, Citrus trees of united states. It was especially prevalent around the roots of declining apple and cherry orchards. Many new species of this genus has been described of Goodey 1936, Thorne 1937, and Schuurman, Stekhoven and Teunissen 1938. However, nematologists become very much interested in the genus <u>Xiphinema</u>.

Many species of this genus were shown to be vectors of plantviruses by certain nematologists as Hewitt <u>et</u> <u>al</u>., 1958; Harrison, 1960, 1964; Pitcher, 1961 and 1965; Cadman, 1963; Vuittenez, 1963 and Raski & Hewitt, 1963. Luc (1958) presented a very satisfactory key to the species of <u>Xiphinema</u>. Siddiqi added three new species and reported the presence of <u>X</u>.<u>americanum</u> and <u>X</u>.<u>brevicaudatum</u> in India. Luc and Tarjan (1963) published a note on the systematics of <u>Xiphinema</u> and listed twenty nine valid and nine inquirende species. Dalmasso (1960) described new species of this genus from France and listed them in four groups Viz. *X.americanum* group, *X.italiae* group, *X.diversicaudatum* group, and *X.basiri* group, Mcleed and Khair (1971) presented a key for the monodelphic species of genus *Xiphinema*.

Several species of the genus *Xiphinema* were reported from Surinam by Loof and Mass (1972) and described a dichotomous key for the identification of all the species. Cohn and Sher (1972) proposed eight sub genera under *Xiphinema* Viz. *Xiphinema*, *Radiphinema*, *Krugiphinema*, *Halliphinema*, *Elongiphinema*, *Basiphinema*, *Diversiphinema* and *Rotundiphinema*. They also farmulated a key for the separation of the nominal species.

At present time there are more than forty described species in the genus *Xiphinema*. Nearly thirteen of these have been described since 1950. In view of the fact that one of these species is a vector of Fan- leaf virus of grapes, we can look farward to considerable more world wide interest in this group of nematodes. Beside from their potential vectors of virus diseases, these nematodes are able to parasitise plants and cause considerable root damage which results in deterioration of the plant.

Roy and Gupta (1974) added ninth subgenus, *Filliphinema* giving a key to the species grouped under ninth sub genera. Southey (1973), Luc and Dalmasso (1975) and Bajaj & Jairajpuri (1979) out-right rejected the sub division of Xiphinema on the ground that the different genera do not show any phylogenetic relationship. In place of subgenera Southey (1973) preferred to use the term "groups". He also gave a key to the species of Xiphinema under various groups recognised by him.

Luc and Dalmasso (1975) presented a polytomous key using a wider range of biometric characters. Recently Bajaj and Jairajpuri (1979) revised the genus Xiphinema, in which they included seventy four valid species under five groups and provided a dichotomous key for their identification.

Many species of the dagger nematode Xiphinema Cobb, 1913 have been reported from India. Siddiqi (1959) reported three new species Viz. X.indicum, X.basiri and X.citri from Aligarh. Later on he added other species X.opisthohysterum (1961) from Aligarh and X.arbum (1964) from Patna. From Ranikhet (1961) X.arcum described by Khan (1964) and X.crotoni from Lucknow by Singh (1971). A new species X.neoamericanum recorded from Ludhiana by Saxena et al. (1973). Then Khan and Ahmad (1975) described a new species from juglan regia and named it *X.neoamericanum* which was later changed to *X.inaequale* in 1977.

Bajaj and Jairajpuri (1976 and 1979) described *X.lampertic*; *X.neoelongatum* and *X.luci*. The name of *X.luci* was changed to *X.bajaji* by Jairajpuri and Lamberte (1980). Khan *et al*. (1976) reported a new species *X.elitum* from the roots of paddy from Andman Islands. Three new species of Xiphinema Viz. *X.nagarjunensis*; *X.mammillocaudatum* and *X.neodimorphicaudatus* has been described by Khan (1981) with two known species. Sharma and Saksena (1981) described *X.cobbi* and *X.indica* from Bareilly. A new species *X.tugewai* was reported by Darekar and Khan (1982) from the rhizosphere of guava from Pune.

Xiphinema basiri Siddiqi, 1956

(Plate 31 Fig.64 Plate 32 Fig.65, 66
Plate 33 Fig. 67, 68)

Fifteen Females Paratype)

L = 3.65 (3.21-3.95)mm.	;	a = 63.50 (56.5-74.0)
b = 8.9 (7.5-9.8)	;	C = 65.50 (52.6-82.4)
C' = 1.6 (1.3-2.0)	;	V = 50.50 (47.4-52.5)
G_1 = 9.5 (7.5-11.3)	;	G_2 = 9.50 (7.5-11.5)
VL/VB = 24.80 (16.70-33.10)	;	Odontostyle = 12.00 (112.00-126.00)µm.
Odontophore = 64.50 (58.00-70.00)µm	;	Spear = 185.00 (173.00-191.00)µm

Guiding ring = 95.5 (85.0 - 106.0µm.

Female (Hototype)

L = 3.65 mm.	;	a = 145.00
b = 10.00	;	c = 65.50
C' = 1.8	;	V = 52.50
G_1 = 10.5	;	G_2 = 10.50
VL/VB = 25.40	;	Odontostyle = 90.00µm
Odontophore = 103.00µm	;	Spear = 185.00µm

Guiding = 95.5µm.

Two Males (Paratype)

L	=	3.75 (3.25-5.25) mm	;	a	=	62.50 (59.20-65.80)	
b	=	10.50 (8.90-11.60)	;	C	=	75.50 (64.20-86.50)	
C'	=	1.50 (1.54-1.60)	;	Odontostyle=124(118.00-129.00)			
			;	Spear=187.50(180.00-195.00) µm			
T	=	53.80 (52.30-55.50)µm	;	Spicules = 65.00 µm			

Odontophore = 65.50 (65.0-67.0) µm

Guiding ring = 90.0 (80.100.00)µm

Male (Hototype)

L	=	3.75 mm	;	a	=	62.50
b	=	10.50	;	C	=	75.50
C'	=	1.50	;	Odontostyle = 124.00 µm		
T	=	53.80	;	Spear = 187.50 µm.		
Odontophore = 65.50 µm			;	Spicules = 65.00 µm.		

Guiding ring = 90.00 µm.

FEMALE CHARACTERS

(Plate 31 Fig.64; Plate 33 Fig. 67,68)

The body of female parasite is long, slender and tapering towards the anterior end. It is "J" shape when relaxed by gently heating. Its cuticle is smooth and 3-4 µm in thick mid body, increasing to 5 µm in anterior part of neck and 6-7 on dorsal part of tail. Radial striae are not visible on tail region. Lateral chords measures about 1/3 of the mid body width.

The lip region is semicircular, set-off from the body by a slight depression, but not expanded. It measures 13-15 µm in breadth and 8-10 µm in length. Amphids are stirrup shaped and cover about three fourth of the head breadth. Odontostyle is long and slender about 120.00 (112.00-126.00) µm positeriorly it is jounted with *odontophore* which is 64.50 (58.00-70.00)µm about half of the length of odontostyle length. The odontophore bears distinct swellings at its base in the form of flanges. The fixed guiding ring is at 95.6 (85.00-107.00) µm or 7.0-8.6 labial breadth from the anterior end.

Oesophagus is well developed and measures 408 (365-440) µm in length from the anterior end. Oesophageal bulb is bottle shaped or rectangular, measuring 103 (90-119) µm in length and 23 (20-28) µm in breadth. Conoid Cardia are present at the junction of oesophagus and intestine. Nerve ring is placed behind the base of spear extent at 225 (200-250) µm from the anterior end. Intestine is large and packed with hyaline granules. Pre-rectum is 15-17 anal body width long and indistinct in many specimens. Rectum is tubular, 30-50 µm in length and opens to exterior by means of a prominent anus.

Female genital tract is didelphic and amphidelphic. Anterior branch is slightly shorter than the posterior one. Valva is transversellly placed and leads into vagina which is one half vulval body width long. It joins a broad uterine chamber. Uteri are long with muscular walls.

The "Pseudo Z Organ" is not very much distinct from adjacent part of uterus. It is provided with poorly developed muscles and contains few granules of various sizes. There are two ovaries which are small and reflexed. Eggs are present, but not more than two eggs could be observed in one specimen at a time. They measures 165-170 µm in length and 51-55 µm in breadth.

The tail is small, conoid-digitate about 55.5 (45.5-72.0) µm in length and 34.5 (30.0-42.0) µm in breadth. Two to three pairs of caudal papillae are present. The inner sufface of the tail tip is without a conical blind canal or any apical muff.

MALE CHARACTERS

(Plate 32 Fig.65, 66)

The male are not very common. Only two males in comparison to fifteen females were obtained during investigation. The shape and structure of body is similar to femaIe expect for the more curvature at the posterior end.

There are two testes which shows typical dorylaimid structure. The spicules are distally cephalated and ventrally arcuate, and measure about 65 um in length. They are strengthened with two accessory rode like pieces, the dorsal piece is solid while ventral piece is bifurcated.

The tail is conoid 48-51 µm in length and ending in a digitate terminus. It is provided with two pairs of caudal papillae.

Habitat : The worm was collected from the soil around the root of Bougainvillea,(Bougainvilea sp.)

Locality : Ratahara, Rewa (M.P.).

DISCUSSION

Although the present population of *Xiphinema* nematodes resembles with *X.basiri* Siddiqi 1959. However, it differs in having a longer body, in the position of nerve ring and posterior genital branch longer than the anterior one. According to the consideration of previous observation of Loof and

Yassian 1970; Cohn and Sher, 1972; Knobloch and Laughlin, 1973; Bajaj and Jairajpuri, 1977 & 1979 and Roy 1980, these variations are not enough to separate this population as a new species.

Xiphinema basiri is closely related with X.ifacolum Luc, 1961 and X.coxi Tarjan, 1964. Cohn and Sher (1972) synonymized X.basiri on the basis of overlaping value of L, a, b, c, v, length of spear, tail shape and in the presence of "Z organ". Luc and Dalmasso (1975) rejected this synonymy on the basis of differences in "z organ" and the structure of tail tip of two species. Xiphinema ifacolum has a "typical Z organ" and the inner surface of the tail tip is without muff but X.basiri has "pseudo Z. organ" and the inner surface of the tail tip is without a larger conical blind canal or any apical muff. The auother fully agree with the latter workers in treating it as a valid species. X.coxi differs from X.basiri only in the value of V. The value of V = 40-44 in X.coxi while it is 46-54 in X.basiri. Bajaj and Jairajpur (1977) observed that position of Valva is least variable in X.basiri, hence this species is clearly different from X.coxi.

This species usually attack fruit trees (Yadav and Verma 1967) but it is also of frequent accurrence around the roots of cereals and herbaceous plants (Bajaj and Jairajpuri, 1979). It causes galling of the roots of tomato (Roy, 1974 and Bajaj & Jairajpuri, 1977). It is suspected to transmit cowpea mosaic virus in Nigeria (Caveness *et al*. 1975).

PLATE 31

Explanation of figure

Xiphinema basari Siddiqi, 1959

Fig. 64 Entire body of female.

PLATE 31

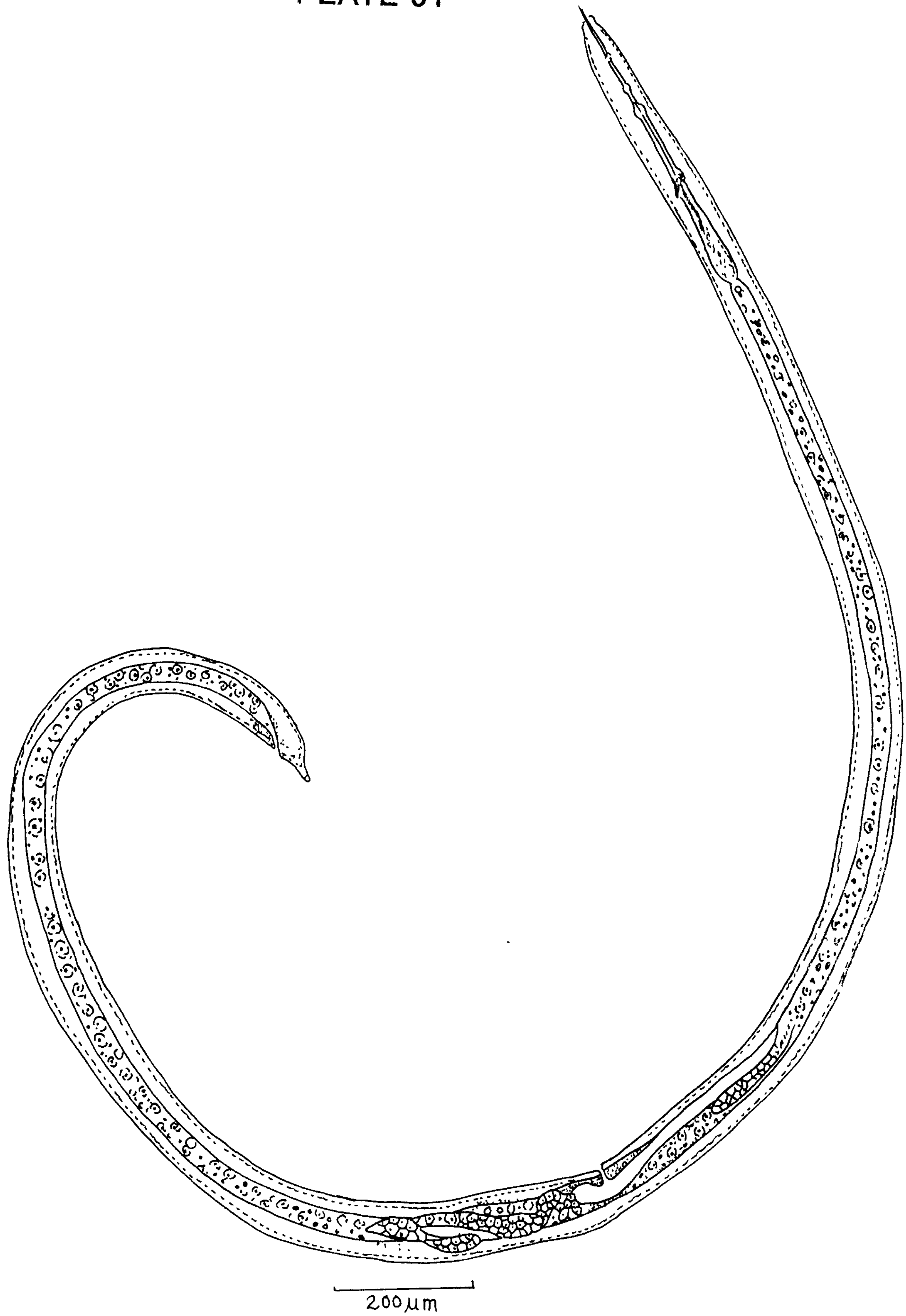


FIG. - 64

PLATE 32

Explanation of figures

Xiphinema basari Siddiqi 1959

Fig. 65 Tail region of male.

Fig. 66 Spear developing in esophageal tissues.

PLATE 32

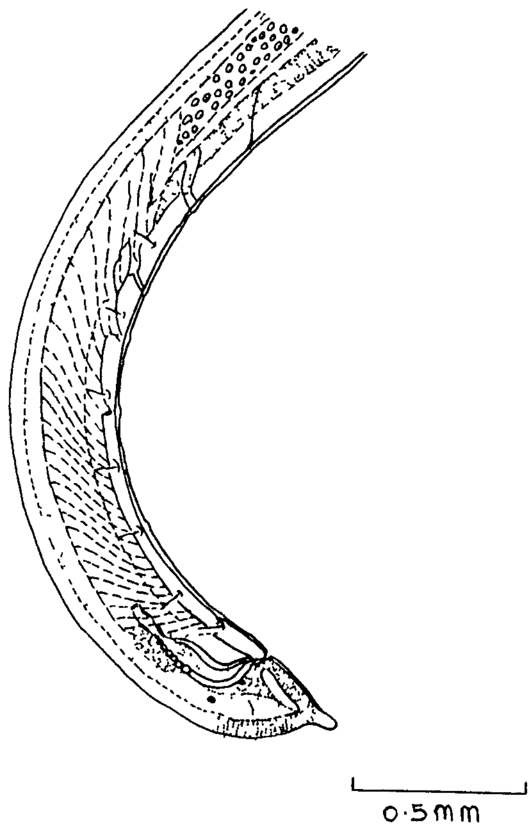


FIG. - 65

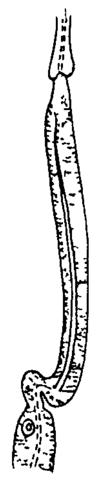


FIG. - 66

PLATE 33

Explanation of figures

Xiphinema basari Siddiqi, 1959

Fig. 67 Tail region of female.

Fig. 68 Anterior region of female.

PLATE 33

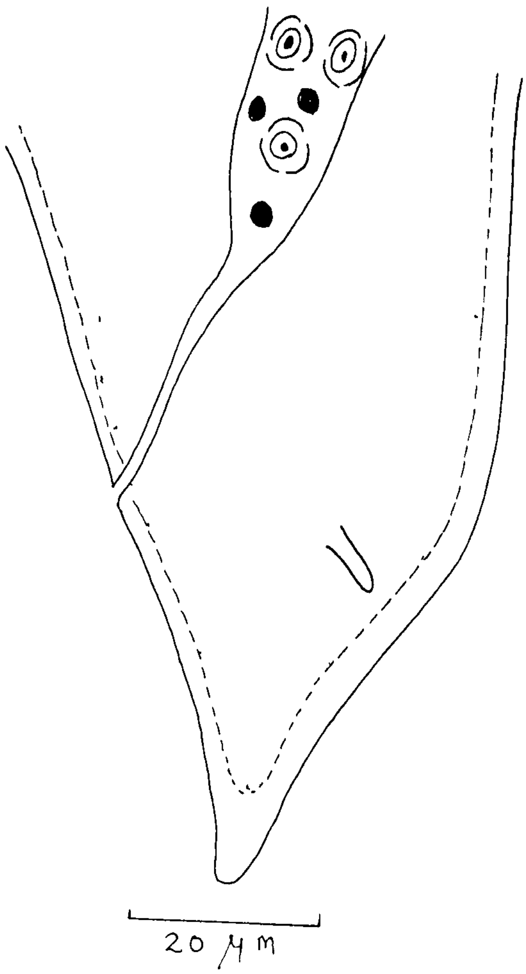


FIG - 67

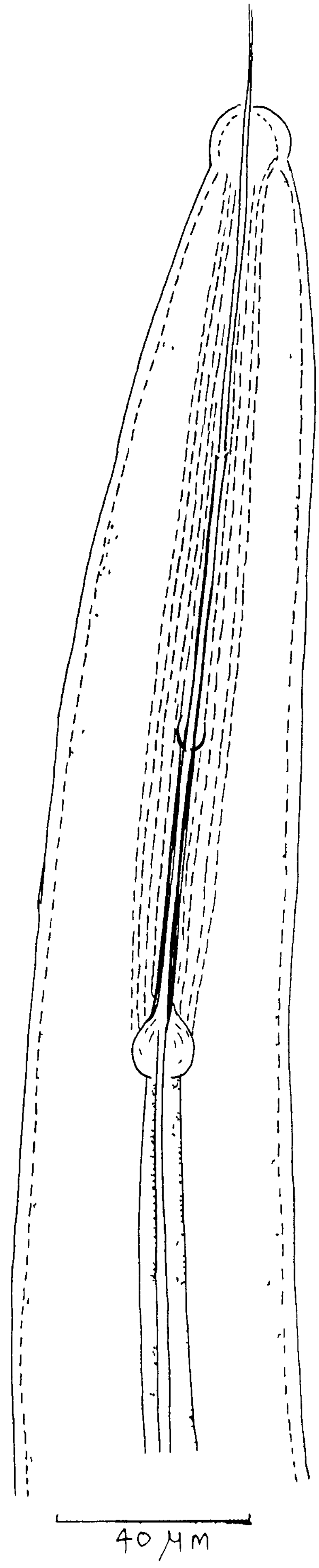


FIG. - 68

SECTION - C

BIO - ECOLOGY

CHAPTER XVI

Bio-ecology

BIO-ECOLOGY

The plant parasitic nematodes is a serious pest of various field crops, vegetables, fruits and ornamental plants in the agricultural areas of Madhya Pradesh which causes enormous loss in production resulting food problem in this state. The genus Tylenchorhynchus has a world-wide deistribution although, the known distribution of many individual species is very restricted (Allen, 1955). The representatives of this genus form a part of general complex of plant nematodes in soil. Reynolds and Evans (1953) found Tylenchorhynchus to be the most prevalent plant-parasitic nematode associated with the roots of natural and cultivated plants. Fielding and Hollis (1956) found Tylenchorhynchus sp. to be the most prevalent nematodes around roots of Rice, Wheat, Soybean, Cotton, Sugarcan, Maize and Berseem.

The Widespread occurrence of plant parasitic nematodes in cultivated soils demands an estimate of soil populations to assess the safety of susceptible crops for minimiging losses in crop yields. Small numbers of some genera reduce enormous yields. According to Jones (1956) and Oostenbrink (1956) the nematode densities and crop losses are not always obviously correlated. Studies of population dynamics and distribution of plant parasitic nematodes at different soil depths under varying influences of environmental stimuli not only provide information with regards of fundamental aspects but they also help in formulating control schedules. For the economic and effective use of nematicides, it is necessary to known the soil depth which the plant nematodes inhabit. Therefore, the author intend to work a seasonal fluctuations density and vertical distribution of Tylenchorhynchus for two consecutive years under field conditions having maize-cowpea and Wheat rotation.

Between Jan. 1993 and Dec. 1994 fortnightly soil samples were collected at different depths viz. 0-10, 10-20 and 20-30 cm. after dividing a field into five equal areas and drawing 250 ml soil from each are to estimate population density, vertical distribution and seasonal fluctuation of Tylenchorhynchus
loam in texture. During different periods of sampling the soil temeperature and relative humidity at different depths were simultaneously recorded with the view to correlate these factors with the population of nematodes. After logarithmic transformation, the data were analysed statistically to ascertain the significance of depth and different factors influencing numbers.

BIOLOGY

(Plate 34 Fig 69,70,71,72 Plate 35 Fig 73,74,75,76
Plate 36 Fig 77,78,79,80)

The number of gravid females were available from nematode suspensions of potted maize soil in the month of Sept., Oct. Observations were made at room temperature and humidity. Oviposition appeared to be simple and rapid process. An increased activity of the female indicate the time of egglaying. During oviposition, the nematode body become curved or 'c' shaped. The eggs were laid in one cell stage.

CLEAVAGE

The single cell eggs with a prominent nucleus at the centre, were oblong to kidney shaped. It is measured 69.5 µm. in length and 20.2 µm in breadth. The first cleavage was transverse, at right angle to longitudinal axis of the egg resulting in two blastomeres of equal size in 3-9 hours. The second and third divisions quickly followed, dividing the cells transversely and producing 4 cells arranged in a row. The fourth cleavage was a longitudinal and accurred about 3 hrs. after the third division producing 5 cells. The six-cell stage was noticed after 2-3 hrs. Beyond this stage it was not possible to follow the sequences because of rapid divisions.

GASTRULA

The gastrula stage was recorded 3-4 days after egglaying. The cells are arranged in a sequence with transparent areas. The tadpole stage are 4-5 days after oviposition. The embryo organise into two zones of different densities. In side the egg cell, the embryo was noticed with the streaming movement of protoplasm, which is followed by appearance of first Juvenile stage 4-5 days after egg deposition. The head end of embryo appeared broad, truncate and hyaline. The tail end slightly narrow, bluntly rounded and hyaline at the distal end.

FIRST JUVENILE

The first juvenile mouted inside the egg shell after 5-7 days of egg laying. The first moulting completed within one day forming 2nd stage of juvenile which was characterised by the development of cephalic from work, strong and fully formed stylet, esophagus and intestine.

SECOND JUVENILE

The second juvenile emereges from the egg, 6-8 days after egg deposition. Before emergening the egg shell become flexible, the yound one moved inside the egg shell vigorously and forms swellings on the elastic wall. The juvenile pieresed the vitelline membrane with the help of stylet. The egg shell was broken into a slit aperture due to pressure of stylet, releasing the juvenile.

THIRD JUVENILE

The third juvenile comparatively larger than the second stage measuring 365-425 μm with stylet 15-18 μm long and gonads 90-120 μm in length. This stage lasted for 4-5 days.

FOURTH JUVENILE

The fourth juvenile increased in length considerably. The length of stylet become 19-20 μm, the gonads measured 150-175 μm. The juvenile remain in this stage for 5 days. Thus the life cycle from egg to adult stage was completed in 28-35 days.

PLATE 34

Explanation of figures

Biology of *Tylenchorhynchus* sp.

Fig. 69 Single-cell egg.

Fig. 70 Two-cell stage

Fig. 71 Four-cell stage

Fig. 72 Five-cell stage

PLATE 34

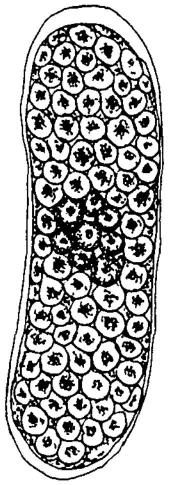


FIG - 69

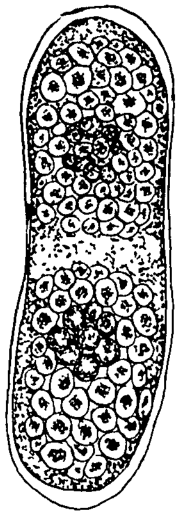


FIG. - 70

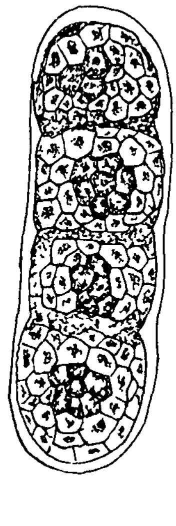


FIG. - 71

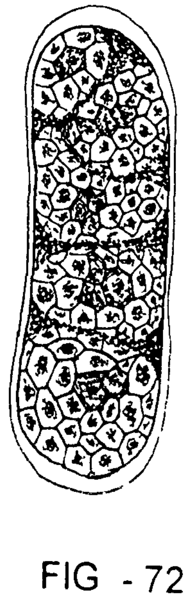


FIG - 72

PLATE 35

Explanation of figures

Biology of Tylenchorhynchus sp.

Fig. 73 Six-cell stage

Fig. 74 Gastrula stage

Fig. 75 Tadpole stage

Fig. 76 Tadpole-shaped juvenile

PLATE 35

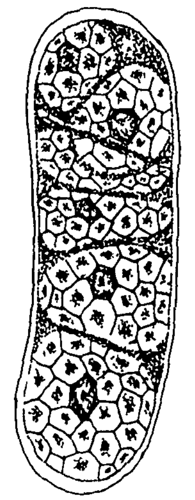


FIG - 73

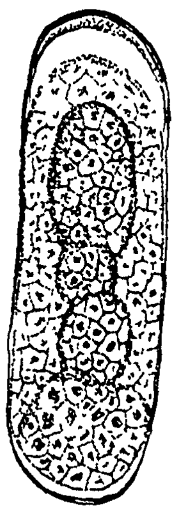


FIG - 74

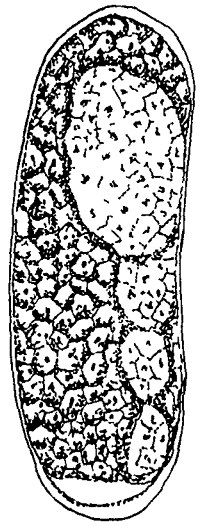


FIG - 75

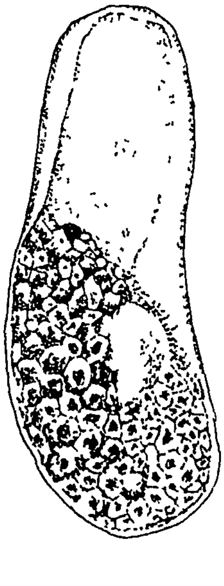


FIG - 76

PLATE 36

Explanation of figures

Biology of Tylenchorhynchus sp.

Fig. 77 First juvenile stage

Fig. 78 Wriggling of the juvenile

Fig. 79 Third juvenile stage

Fig. 80 Fourth juvenile stage

PLATE 36

FIG - 77

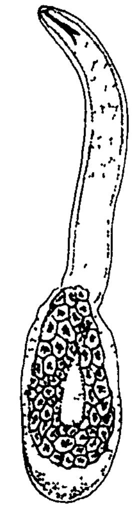


FIG. - 78

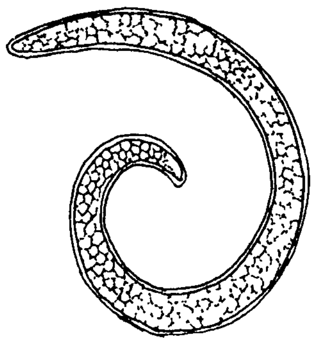


FIG. - 79

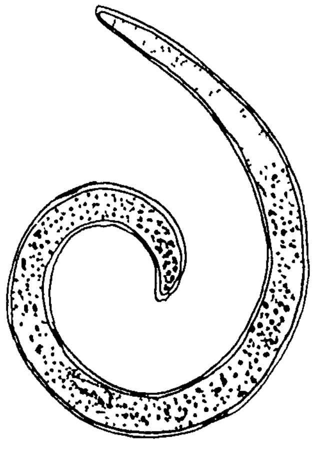


FIG - 80

ECOLOGY

In general the factors such as soil texture, soil structure, soil temperature, rainfall, soil moisture, evaporation, soil conductivety pH and topography are significant enough to effect the population density of plant nematodes. The author has selected to study only two factors, soil temperature and soil moisture in aboitic factors having maize-cowpea and wheat rotation under field conditions.

The study exhibited well defined temperature dependent density oscillation cycles. The table IV-VI & XIII-XV shows that temperature ranges from 13.52-35.95 °C at 0-10 cm depth, 14.26°C-33.80°C at 10-20 cm depth, 14-58 - 32.81°C at 20-30 cm. depth in the year 1993 and 13.85-33.61 at 0-10 cm depth, 15.09-33.36°C at 10-20 cm depth, 15.12-35.75°C at 20-30 cm depth in the year 1994. The Tylenchorhynchus exhibited two peaks - one at 17-23°C and other at 28-32°C soil temperature at all depths. The population at lower soil temperature was invariably higher than that of higher soil temperatures.

To study of the effect of levels of soil moisture on population of the nematode the RH and population of nematodes were recorded in the table VII –IX & XVI-XVIII. The RH (in percent) ranges from

60.35°C-89.15 at 0-10 cm depth, 41.90-89.35 at 10-20 cm depth; 42.50-90.05 at 20-30 cm depth in the year 1993 and 30.95-88.90 at 0-10 depth; 42.85-89.70 at 10-20 cm depth; 42.75-90.15 at 20-30 cm depth in the year 1994. This study indicates that the population of Tylenchorhynchus increase at 45-52 and 79-80 RH in all the depths. The high population of the nematodes was recorded at low soil moisture condition.

The distribution of Tylenchorhynchus in the soil having host crops was restricted mostly in the 0-10 and 10-20 cm soil zone. The juveniles were generaly found in the 0-10 cm as well as in 10-20 cm layer while the adults inhabits mostly 10-20 cm layer. Numerically, females were nearly four time more than the males and three time less than the juveniles. The number of nematodes increased during February to April and in September-October and decrease during December-January and June to August. The abundance of juveniles in 0-10 cm layer was affected during starting of summer.

The number of nematodes recovered from 0-10 cm depth was maximum during March and April. The increase in numbers in the upper layer was mainly due to an increase in the juvenile population. The increase in the adult population was noticeable from the recovery made from 0-10 cm layer. The more nematodes were recovered from monoculture of maize and wheat.

.. ...:. .:..

Table IV

Fortnightly variation in soil temperature at five experimental station (in °C) 0-10 cm. depth from Jan. to Dec. 93.

Date & Month	A	B	C	D	E	Average	Monthly mean
15 Jan	13.23	13.38	13.90	13.23	13.41	13.41	14.69
31 Jan	16.38	16.01	16.05	16.23	15.18	15.97	
14 Feb	17.28	16.81	16.23	17.03	17.20	16.91	16.15
23 Feb	15.45	15.35	15.00	15.80	15.40	15.40	
15 Mar	20.68	20.70	20.69	20.75	20.63	20.69	22.63
31 Mar	24.73	24.43	24.58	24.62	24.54	24.58	
15 Apr	30.62	30.50	30.44	30.12	30.42	30.52	31.42
30 Apr	32.43	32.23	32.33	32.30	32.36	32.33	
15 May	35.48	35.30	35.32	35.28	35.40	35.36	35.95
31 May	36.52	36.58	36.52	35.60	35.48	36.54	
15 Jun	37.37	37.57	37.27	37.67	37.47	37.47	34.13
30 Jun	30.80	29.69	30.09	31.79	30.79	30.79	
15 Jul	32.06	29.03	30.32	29.03	33.01	31.12	31.12
31 Jul	31.20	31.06	31.18	31.08	31.13	31.13	
15 Aug	30.15	30.09	30.08	30.09	30.11	30.12	30.31
31 Aug	80.60	30.44	30.56	30.51	30.49	30.52	
15 Sep	29.16	29.19	29.20	29.09	29.06	29.14	28.78
30 Sep	28.46	28.42	28.22	28.54	28.56	28.44	
15 Oct	27.19	27.17	27.18	27.20	27.16	27.18	25.37
31 Oct	23.62	23.50	23.86	23.50	23.52	23.56	
15 Nov	19.72	19.62	19.52	19.67	19.57	19.62	19.04
30 Nov	18.47	18.48	18.51	18.43	18.42	18.46	
15 Dec	13.71	13.59	13.65	13.70	13.60	13.65	13.52
31 Dec	13.42	13.46	13.52	13.36	13.24	13.40	

Table V

Fortnightly variation in soil temperature at five experimental station (in °C) 10-20 cm. depth from Jan-Dec. 93.

Date & Month	A	B	C	D	E	Average	Monthly mean
15 Jan	13.57	13.53	13.59	13.61	13.65	13.55	14.26
31 Jan	15.02	14.98	19.90	14.68	15.27	14.97	
14 Feb	18.87	16.91	16.97	16.72	16.71	16.80	16.05
28 Feb	15.34	15.42	15.39	15.20	15.15	15.30	
15 Mar	19.38	20.48	20.08	20.01	19.95	19.98	21.76
31 Mar	23.58	23.56	23.51	23.85	23.25	23.55	
15 Apr	27.86	27.96	28.06	27.66	27.56	27.76	28.35
30 Apr	28.98	28.91	28.96	28.99	28.91	28.95	
15 May	32.68	32.62	32.65	32.70	32.60	32.65	33.35
31 May	34.11	33.99	34.06	34.19	33.90	34.05	
15 Jun	36.36	36.46	36.56	36.96	35.96	36.44	33.80
30 Jun	31.20	31.10	31.35	31.03	31.07	31.15	
15 Jul	30.62	30.22	30.42	30.47	30.37	30.42	30.45
30 Jul	30.59	30.37	30.60	30.43	30.41	30.48	
15 Aug	28.50	28.00	26.26	28.30	28.19	28.25	28.68
31 Aug	29.24	29.36	29.00	29.17	28.83	29.12	
15 Sep	28.55	29.35	28.95	29.25	28.65	28.95	28.50
30 Sep	28.15	28.25	27.75	28.08	28.02	28.05	
15 Oct	25.75	25.63	25.66	25.68	25.58	25.64	24.35
31 Oct	23.09	23.03	23.18	22.96	22.98	23.06	
15 Nov	17.72	17.64	17.69	17.67	17.68	17.68	17.46
30 Nov	17.37	17.13	17.31	17.35	17.09	17.25	
15 Dec	15.36	15.37	15.38	15.25	15.24	15.32	14.83
31 Dec	14.75	14.35	14.61	14.62	14.42	14.55	

Table VI

Fortnightly variation in soil temperature at five experimental station (in °C) 20-30 cm. depth from Jan to Dec. 93.

Date & Month	A	B	C	D	E	Average	Monthly mean
15 Jan	13.92	13.72	13.87	13.82	13.77	13.82	14.58
31 Jan	15.41	15.29	15.35	15.25	15.45	15.35	
14 Feb	16.81	16.69	17.00	15.52	16.73	16.75	16.00
28 Feb	15.25	15.35	15.45	15.15	15.05	15.25	
15 Mar	19.18	19.12	19.21	19.09	19.15	19.15	20.85
31 Mar	22.85	22.95	22.55	22.25	22.15	22.55	
15 Apr	26.78	26.54	26.72	26.60	26.66	26.66	28.30
30 Apr	30.05	29.85	29.81	29.82	30.22	29.95	
15 May	31.70	31.10	31.50	31.35	31.45	31.40	32.28
31 May	30.22	33.10	33.30	33.76	32.58	33.16	
15 Jun	34.92	34.96	34.76	34.80	34.96	34.88	32.81
30 Jun	30.81	30.69	30.76	30.77	30.72	30.75	
15 Jul	29.75	29.15	29.45	29.50	29.40	29.45	29.47
31 Jul	29.50	29.70	29.10	29.65	29.55	29.50	
15 Aug	27.62	27.68	27.62	27.59	27.65	27.65	28.56
31 Aug	29.52	29.56	29.60	29.72	29.00	29.48	
15 Sep	28.81	28.85	28.70	28.74	28.65	28.75	28.50
30 Sep	28.35	28.45	28.55	28.00	27.95	28.25	
15 Oct	26.62	26.68	26.60	26.69	26.66	26.65	25.25
31 Oct	23.86	23.87	23.90	23.82	23.80	23.85	
15 Nov	18.78	18.52	18.71	18.61	18.62	18.65	18.04
30 Nov	17.74	18.44	17.14	17.04	16.84	17.44	
15 Dec	16.37	16.57	16.47	16.12	16.07	16.32	15.00
31 Dec	13.74	13.78	13.99	13.39	13.65	13.69	

PLATE 37

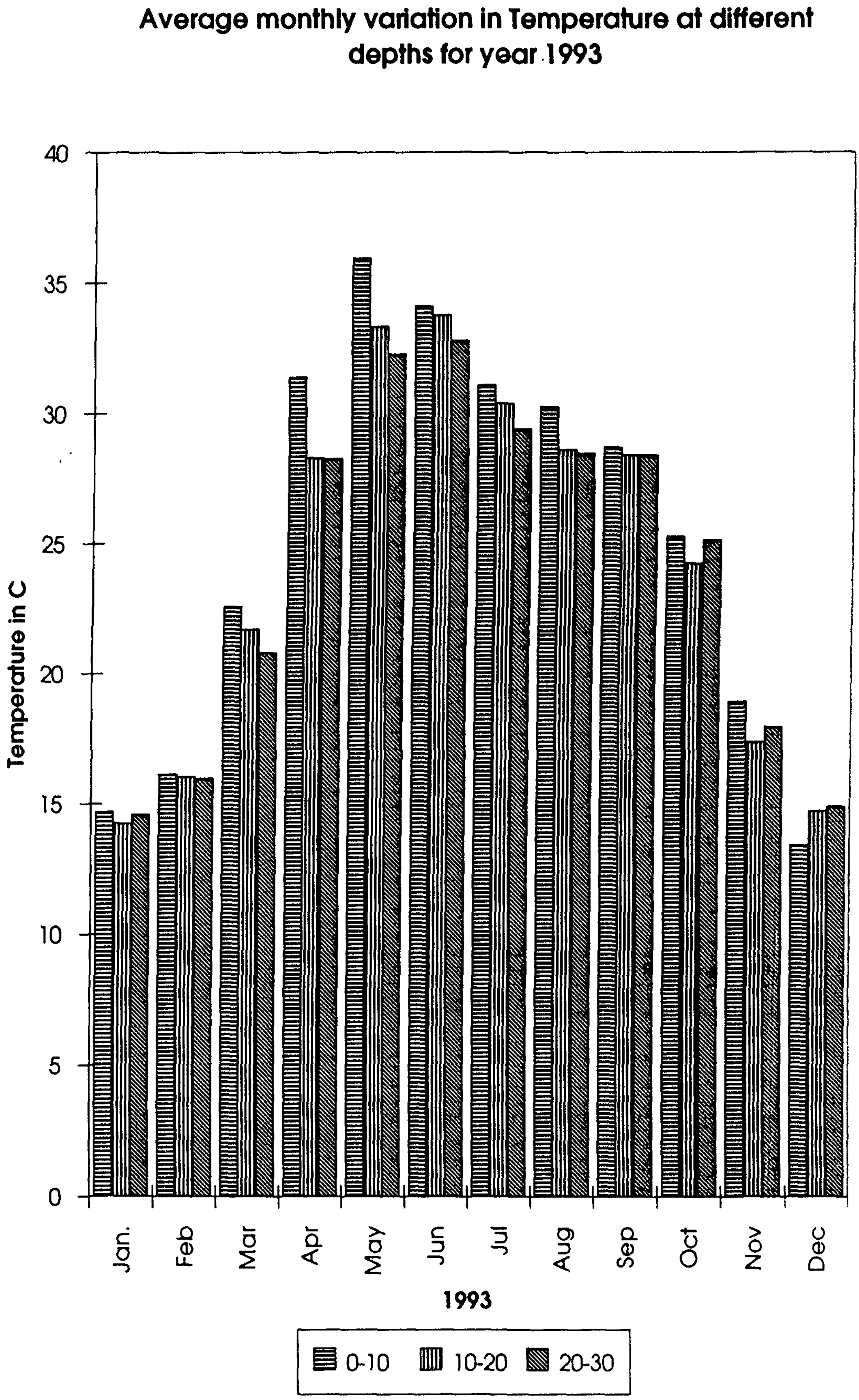


FIG. - 81

Table VII

Fortnightly variation in R.H. (in percent) at five experimental station at 0-10 cm. depth from Jan to Dec. 93.

Date & Month	A	B	C	D	E	Average	Monthly mean
15 Jan	89.3	89.4	89.5	89.8	88.0	89.5	89.15
31 Jan	89.2	89.0	89.5	89.6	88.6	89.1	
14 Feb	87.6	87.7	87.8	87.9	86.0	87.5	84.70
28 Feb	81.1	81.2	82.3	82.4	82.5	81.9	
15 Mar	74.81	75.01	74.7	74.6	75.4	74.9	69.95
31 Mar	65.1	65.2	64.7	65.2	64.8	85.0	
15 Apr	50.1	49.7	49.88	49.92	49.92	49.9	45.85
30 Apr	41.82	41.78	41.85	41.75	41.8	41.8	
15 May	39.6	39.4	39.5	39.7	39.3	39.5	40.85
31 May	42.4	42.0	41.6	42.8	42.2	42.2	
15 Jun	35.6	35.0	34.9	35.4	35.6	35.3	44.85
30 Jun	54.7	54.1	54.4	54.5	54.3	54.4	
15 Jul	86.2	86.3	85.8	86.0	86.2	86.1	85.50
31 Jul	84.1	85.7	85.0	84.9	84.8	84.8	
15 Aug	80.2	80.3	79.5	80.7	79.3	80.8	81.40
31 Aug	83.0	82.6	82.75	82.8	82.85	82.8	
15 Sep	83.0	82.1	82.4	82.62	82.38	82.5	82.85
30 Sep	83.3	83.4	82.9	82.12	83.28	23.2	
15 Oct	79.01	79.02	78.97	79.2	78.8	79.0	73.95
31 Oct	79.0	78.8	78.7	79.1	78.9	78.9	
15 Nov	75.0	74.0	74.8	74.4	74.3	74.5	79.00
30 Nov	83.6	83.7	83.2	83.9	83.1	83.5	
15 Dec	80.02	80.48	79.5	80.1	79.9	80.0	82.80
31 Dec	85.7	85.4	85.5	85.72	85.48	85.6	

Table VIII

Fortnightly variation in R.H. (in percent) at five experimental station at 10-20 cm. depth from Jan to Dec. 93.

Date & Month	A	B	C	D	E	Average	Monthly mean
15 Jan	89.2	89.8	89.1	89.55	89.85	89.5	89.35
31 Jan	81.1	89.0	89.2	89.65	89.05	89.2	
14 Feb	87.5	88.1	87.75	87.65	88.0	87.8	84.90
28 Feb	82.15	81.85	82.2	82.3	81.5	82.0	
15 Mar	75.13	75.05	75.2	75.15	75.05	75.1	70.15
31 Mar	65.1	65.3	64.9	65.5	65.2	65.2	
15 Apr	50.4	50.5	50.3	50.1	50.2	50.3	46.25
30 Apr	42.3	42.0	42.1	42.4	42.2	42.2	
15 May	39.8	39.9	39.7	40.0	39.6	39.8	41.90
31 May	44.1	44.7	44.2	44.4	43.6	44.0	
15 Jun	35.7	35.6	35.8	35.2	36.6	35.6	45.30
30 Jun	55.2	55.3	45.5	55.1	54.9	55.0	
15 Jul	86.2	86.3	86.6	86.5	86.4	86.4	85.70
31 Jul	85.0	85.1	84.9	84.8	85.2	85.0	
15 Aug	80.0	80.3	80.1	80.6	80.0	80.2	81.85
31 Aug	83.1	83.2	83.9	83.3	84.0	83.5	
15 Sep	83.0	82.8	82.7	83.1	82.9	82.9	83.25
30 Sep	83.7	83.65	83.8	83.55	83.6	83.6	
15 Oct	79.5	79.52	79.98	79.65	79.65	79.5	79.40
31 Oct	79.22	79.38	79.1	79.2	79.6	79.3	
15 Nov	74.5	75.1	74.75	74.85	74.8	74.8	79.25
30 Nov	83.65	83.55	83.7	83.75	83.85	83.7	
15 Dec	80.0	80.2	83.7	80.3	80.1	80.2	83.05
31 Dec	86.1	85.7	85.75	85.8	86.15	85.9	

Table IX

Fortnightly variation in R.H. (in percent) at five experimental station at 20-30 cm. depth Jan to Dec. 93.

Date & Month	A	B	C	D	E	Average	Monthly mean
15 Jan	90.15	90.17	84.98	90.3	89.9	90.1	90.05
31 Jan	90.1	90.3	90.0	89.9	89.7	90.0	
14 Feb	88.6	88.7	88.8	88.1	88.3	88.5	85.25
28 Feb	82.1	81.8	82.8	82.3	81.6	82.0	
15 Mar	75.3	75.1	75.2	75.6	74.8	75.2	70.30
31 Mar	65.45	65.35	65.25	65.55	65.4	65.4	
15 Apr	50.56	49.6	50.9	50.44	50.7	50.5	46.50
30 Apr	42.7	42.4	42.6	42.8	42.0	42.5	
15 May	40.1	40.15	39.85	40.15	39.75	40.0	42.50
31 May	45.15	45.25	44.9	49.65	45.05	45.0	
15 Jun	36.1	36.2	36.05	35.7	35.95	36.0	45.79
30 Jun	55.3	55.7	55.0	56.01	55.4	55.5	
15 Jul	86.67	86.53	86.2	87.0	86.6	86.6	86.05
31 Jul	85.45	85.55	85.38	85.57	85.55	85.5	
15 Aug	80.23	80.47	80.50	80.46	80.34	80.4	82.10
31 Aug	83.8	83.77	83.81	83.6	84.0	83.8	
15 Sep	83.15	83.35	83.25	83.05	83.2	83.2	83.75
30 Sep	84.31	84.28	84.32	84.35	84.25	84.3	
15 Oct	79.79	79.82	79.71	79.84	79.8	79.8	79.70
31 Oct	79.61	79.62	79.57	79.3	79.9	79.6	
15 Nov	84.17	84.27	84.31	81.1	84.15	84.2	79.60
30 Nov	80.61	84.27	84.31	81.1	81.1	84.75	
15 Dec	80.61	80.41	80.43	80.57	80.58	80.5	84.00
31 Dec	47.47	87.52	87.56	87.45	87.54	87.5	

PLATE 38

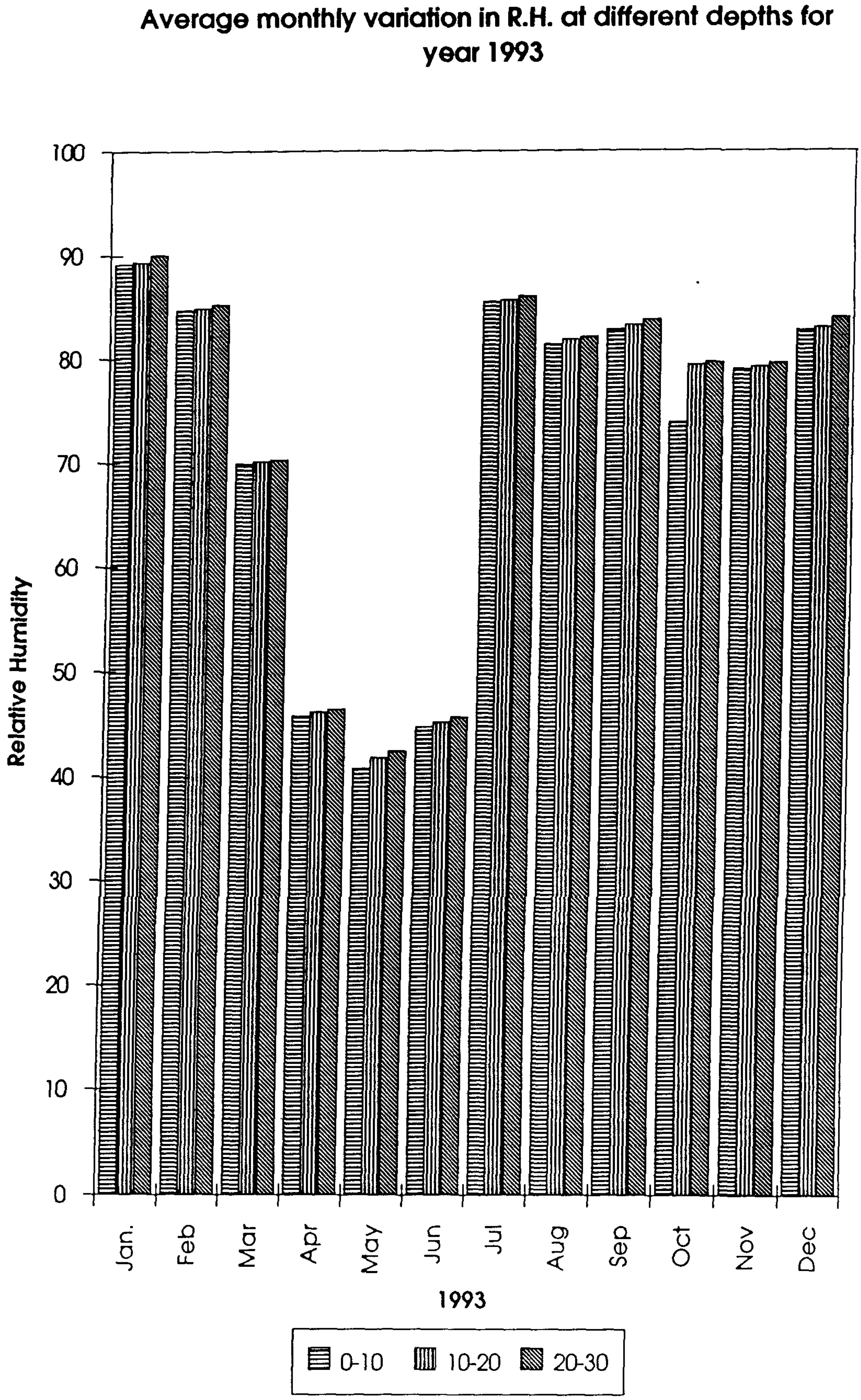


FIG. - 82

Table X

Fortnightly variation in vertical distribution of Tylenchorhynchus recovered from 250 ml Soil 0-10 cm. depth, at five experimental station from Jan to Dec. 93.

Date & Month	A	B	C	D	E	Average	Monthly mean
15 Jan	840	860	865	800	885	850	892
31 Jan	970	900	941	929	935	935	
14 Feb	1170	1200	1135	1190	1230	1185	1195
28 Feb	1220	1230	1200	1185	1180	1205	
15 Mar	1310	1422	1366	1395	1337	1366	1455
31 Mar	1550	1585	1500	1520	1560	1545	
15 Apr	1830	1866	1880	1818	1846	1848	1894
30 Apr	1960	1900	1978	1885	1957	1934	
15 May	585	630	600	570	675	612	603
31 May	592	495	618	645	600	594	
15 Jun	470	490	455	515	485	485	458
30 Jun	430	460	400	405	458	431	
15 Jul	580	626	612	600	597	603	639
31 Jul	650	701	674	690	660	675	
15 Aug	915	900	930	995	910	910	952
30 Aug	1001	989	955	1010	1020	995	
15 Sep	1120	1144	1164	1100	1132	1132	1188
30 Sep	1250	1210	1275	1185	1315	1245	
15 Oct	1720	1770	1685	1675	1710	1690	1722
31 Oct	1785	1723	1748	1760	1754	1754	
15 Nov	1760	1774	1785	1700	1828	1767	1791
30 Nov	1801	1829	1820	1809	1826	1825	
15 Dec	732	710	770	685	758	731	743
31 Dec	752	710	760	776	777	755	

Table XI

Fortnightly variation in vertical distribution of Tylenchorhynchus recovered from 250 ml Soil of 10-20 cm. depth at five experimental station from Jan to Dec. 93.

Date & Month	A	B	C	D	E	Average	Monthly mean
15 Jan	950	940	970	914	900	935	956
31 Jan	990	966	982	910	1042	978	
14 Feb	1220	1200	1229	1180	1251	1216	1296
28 Feb	1371	1381	1376	1400	1352	1376	
15 Mar	1584	1554	1574	1600	1543	1574	1684
31 Mar	1784	1804	1764	1794	1824	1794	
15 Apr	1970	1990	2040	1960	1950	1980	2122
30 Apr	2275	2255	2215	2345	2235	2265	
15 May	971	901	891	911	931	921	754
31 May	587	590	584	597	577	587	
15 Jun	524	544	584	514	504	534	523
30 Jun	513	500	526	500	536	513	
15 Jul	720	740	730	680	780	730	802
31 Jul	825	925	850	901	874	875	
15 Aug	1023	995	1098	1000	994	1022	1133
31 Aug	1115	1175	1195	1100	1140	1145	
15 Sep	1363	1295	1420	1404	1333	1263	1401
30 Sep	1440	1428	1488	1401	1437	1439	
15 Oct	1992	2002	1997	1900	2094	1997	2132
31 Oct	2225	2275	2325	2201	2224	2250	
15 Nov	2275	2195	2320	2300	2305	2315	2295
30 Nov	2306	2324	2340	2300	2305	2315	
15 Dec	906	936	920	900	943	921	883
30 Dec	846	800	890	873	826	845	

Table XII

Fortnightly variation in vertical distribution of <u>Tylenchorhynchus</u> recovered from 250 ml. Soil of 20-30 depth at five experimental stations from Jan to Dec. 93.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	531	561	576	542	520	546	515
31 Jan	475	495	535	455	465	485	
14 Feb	457	479	418	488	498	468	547
28 Feb	637	613	607	648	600	627	
15 Mar	814	780	790	831	770	797	856
31 Mar	930	900	915	880	950	915	
15 Apr	1040	1032	1046	1056	1006	1036	1060
30 Apr	1050	1118	1094	1074	1084	1084	
15 May	660	602	635	628	630	631	587
31 May	550	536	593	523	513	543	
15 Jun	225	200	220	160	270	215	276
30 Jun	308	366	322	340	349	337	
15 Jul	400	434	415	313	427	418	460
31 Jul	495	513	526	500	483	503	
15 Aug	670	650	710	640	630	660	678
31 Aug	701	693	637	717	737	697	
15 Sep	738	722	760	719	720	730	751
30 Sep	770	776	750	797	772	773	
15 Oct	836	796	800	830	812	816	831
31 Oct	841	853	897	827	817	847	
15 Nov	930	900	967	920	928	929	778
30 Nov	1030	1000	1076	995	1041	1028	
15 Dec	581	593	601	550	624	587	550
30 Dec	530	515	494	543	843	513	

PLATE 39

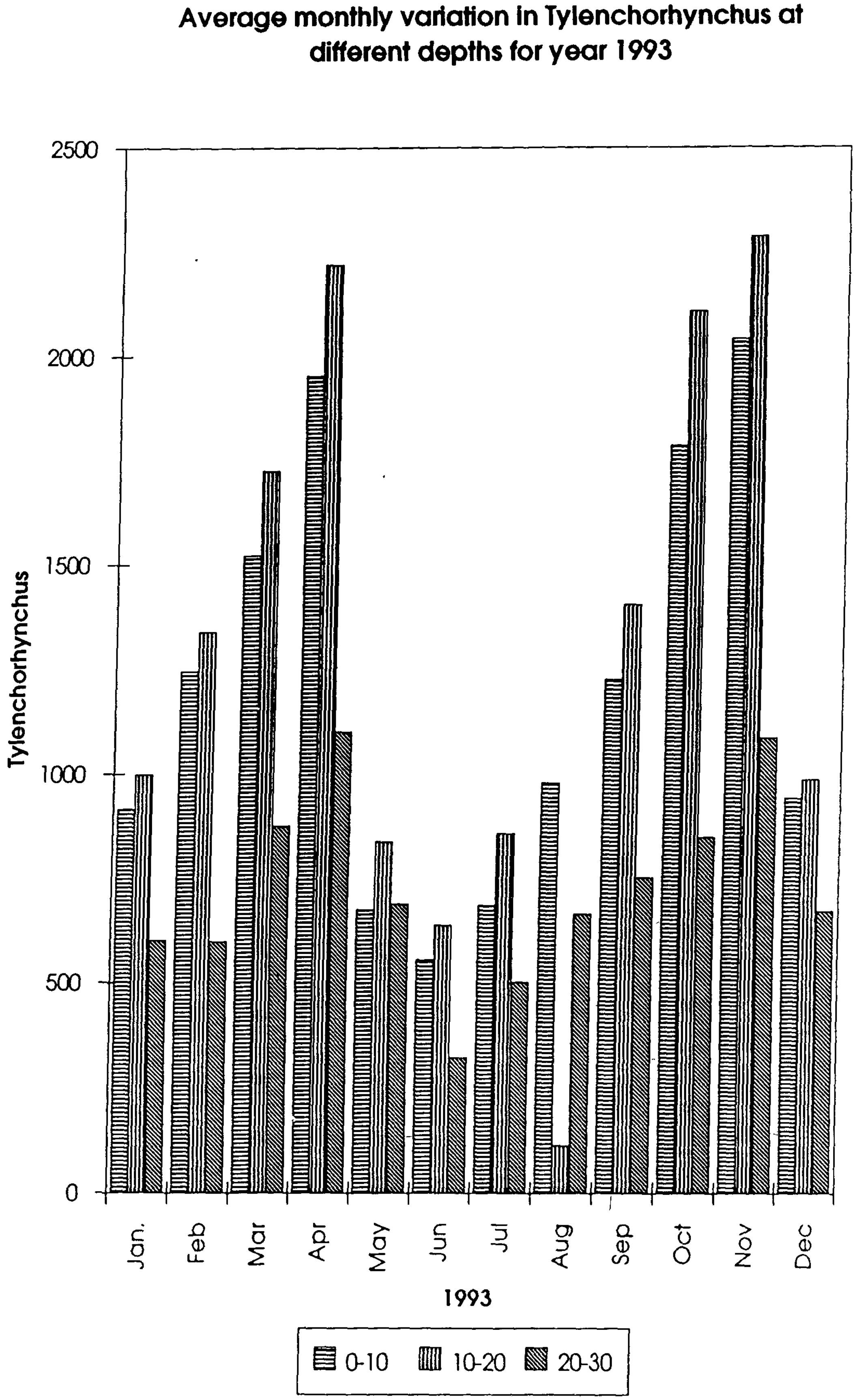


FIG. - 83

Table XIII

Fortnightly variation in Soil temperature at five experimental station (in °C) 0-10 cm. depth from Jan to Dec. 94.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	14.32	14.52	13.50	14.22	13.98	14.10	14.82
31 Jan	15.63	15.43	15.53	15.58	15.48	15.53	
14 Feb	16.38	16.30	15.39	16.64	17.04	16.34	15.92
28 Feb	15.62	15.55	15.33	15.56	15.44	15.50	
15 Mar	19.99	19.85	20.01	19.82	19.81	19.87	21.84
31 Mar	23.86	23.96	23.61	23.88	23.76	23.81	
15 Apr	29.36	29.56	30.96	29.99	29.93	29.96	30.92
30 Apr	31.82	31.94	31.85	31.89	31.85	31.88	
15 May	32.44	32.46	32.10	32.39	32.29	32.34	33.58
31 May	34.86	34.80	34.83	34.89	34.77	34.83	
15 Jun	36.58	36.50	36.54	36-84	36.24	36.54	33.61
30 Jun	30.73	30.78	30.58	30.70	30.61	30.68	
15 Jul	31.62	31.54	31.66	31.58	31.50	31.58	31.45
31 Jul	31.42	31.52	31.22	31.32	31.12	31.32	
15 Aug	30.48	30-38	30.45	30.47	30.37	30.43	30.58
31 Aug	30.86	30.62	30.85	30.70	30.67	30.74	
15 Sep	29.98	29.92	29.99	30.00	29.86	29.95	29.45
30 Sep	30.02	28.83	30.00	28.73	28.82	28.88	
15 Oct	27.61	27.51	27.86	27.36	27.46	27.56	26.36
31 Oct	25.27	25.37	25.17	25.07	24.97	25.17	
15 Nov	23.82	23.87	23.97	23.97	24.02	23.92	22.02
30 Nov	20.23	20.33	20.13	20.03	19.93	20.13	
15 Dec	13.91	14.01	12.98	13.46	13.48	13.96	13.85
31 Dec	14.15	13.85	14.00	13.50	13.25	13.25	

Table XIV

Fortnightly variation in Soil temperature at five experimental station (in °C) 10-20 cm. depth from Jan to Dec. 94.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	14.62	14.56	14.50	14.42	14.40	14.50	15.09
31 Jan	15.73	15,78	15.74	15.62	15.53	15.53	
14 Feb	16.38	16.08	16.33	16.13	16.23	16.23	15.86
28 Feb	15.49	15.47	15.48	15.50	15.51	15.49	
15 Mar	19.87	19.79	19.23	19.33	29.93	19.83	21.79
31 Mar	23.55	23.95	23.72	23.70	23.82	23.75	
15 Apr	29.91	29.71	29.81	29.82	29.75	29.81	30.38
30 Apr	30.98	30.92	31.65	30.65	30.55	30.95	
15 May	31.82	31.77	31.67	31.72	31.62	31.72	32.59
31 May	33.37	33.47	33.57	33.87	33.07	33.47	
15 Jun	35.82	36.06	35.92	35.86	36.04	35.94	33.36
30 Jun	30.68	30.58	30.98	30.48	30.18	30.78	
15 Jul	31.27	31.13	31.00	31.12	31.08	31.12	30.83
31 Jul	30.56	30.52	30.62	30.63	30.42	30.55	
15 Aug	30.41	30.43	30.36	30.48	30.32	30.40	30.53
31 Aug	30.37	30.79	30.47	30.88	30.66	30.67	
15 Sep	29.12	30.72	29.42	29.12	29.22	29.92	29.306
30 Sep	28.15	28.65	28.55	28.45	29.55	28.85	
15 Oct	27.73	27.80	27.61	27.18	28.28	27.68	26.90
31 Oct	26.17	26.07	26.24	26.30	25.95	26.12	
15 Nov	24.32	24.38	24.39	24.40	24.31	24.36	22.46
30 Nov	20.67	20.57	20.97	20.47	20.17	20.57	
15 Dec	15.31	15.21	15.02	15.27	15.44	15.25	15.19
31 Dec	15.28	14.98	15.16	15.20	15.03	15.13	

Table XV

Fortnightly variation in Soil temperature at five experimental station (in °C) 20-30 cm. depth from Jan to Dec. 94.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	14.96	14.62	14.64	14.06	14.52	14.56	15.12
31 Jan	15.75	15.64	15.89	15.61	15.57	15.69	
14 Feb	16.28	16.29	16.24	16.20	16.34	16.27	15.92
28 Feb	15.62	15.50	15.43	15.60	15.65	15.56	
15 Mar	20.11	20.20	19.90	20.05	19.99	20.05	21.99
31 Mar	23.82	24.06	23.90	23.98	23.99	23.94	
15 Apr	30.18	30.12	30.00	30.15	30.30	30.15	30.70
30 Apr	31.36	31.16	31.06	31.31	31.41	31.26	
15 May	32.01	31.89	31.92	31.96	31.97	31.95	33.15
31 May	34.31	34.30	34.36	34.42	34.41	34.36	
15 Jun	36.33	36.73	36.13	36.43	35.53	36.23	35.75
30 Jun	31.21	31.15	31.12	31.18	31.24	31.18	
15 Jul	31.12	31.14	31.16	31.20	31.88	31.10	30.76
31 Jul	30.33	30.53	30.43	30.48	30.38	30.43	
15 Aug	30.45	30.53	30.43	30.48	30.38	30.43	30.49
31 Aug	30.78	30.60	30.54	30.70	30.58	30.64	
15 Sep	29.38	29.58	29.60	29.36	39.48	29.48	29.12
30 Sep	28.80	28.72	28.71	28.72	28.85	28.76	
15 Oct	27.62	27.50	27.57	27.52	27.65	27.56	26.83
31 Oct	26.21	26.11	26.12	26.16	26.80	26.10	
15 Nov	24.41	24.32	24.36	24.35	24.11	24.31	22.38
30 Nov	20.35	20.45	20.55	20.25	20.65	20.45	
15 Dec	15.11	15.29	15.31	15.09	15.20	15.20	15.25
31 Dec	15.06	15.07	15.05	15.65	14.45	15.05	

PLATE 40

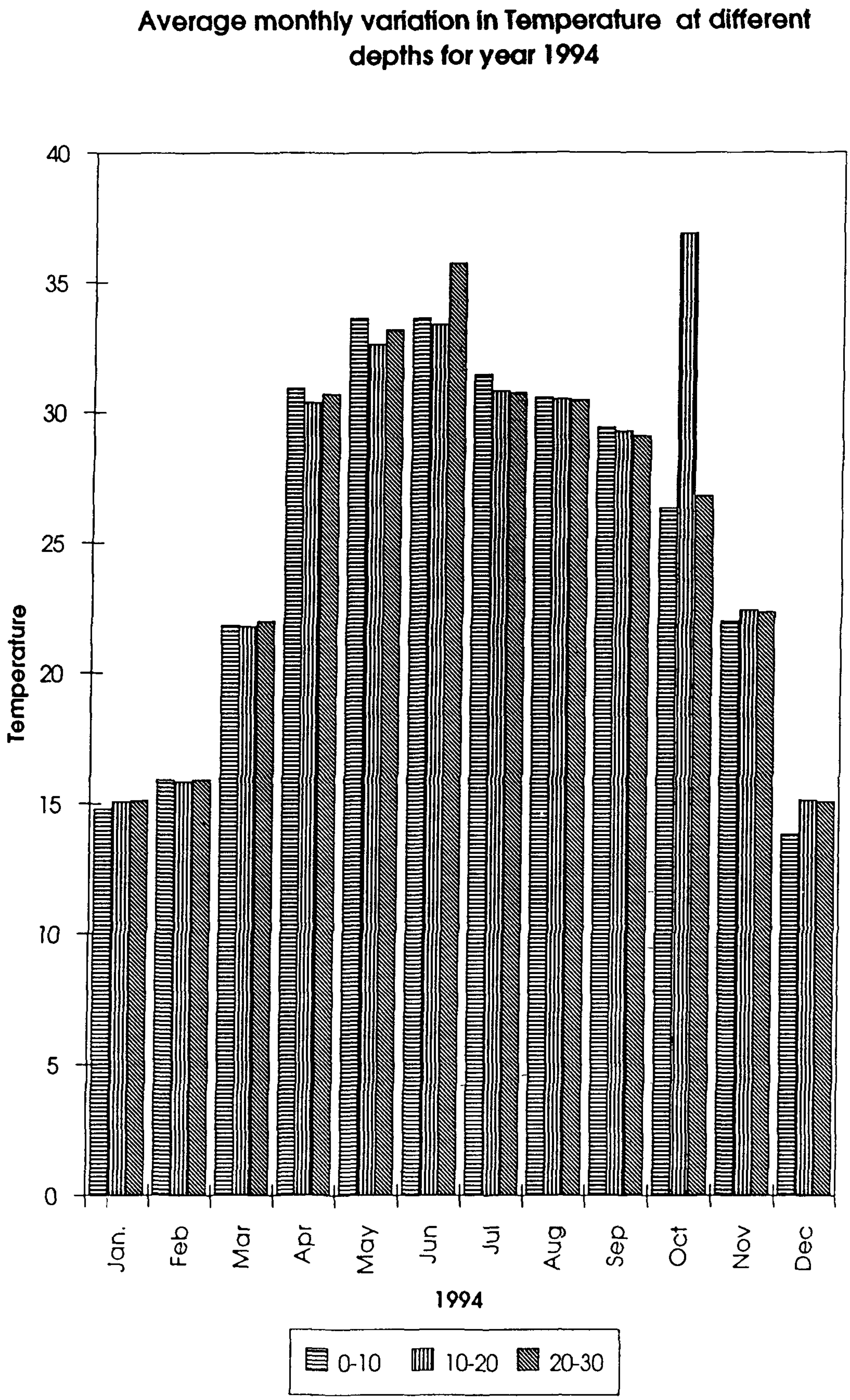


FIG. - 84

Table XVI

Fortnightly variation in R.H. (in percent) at five experimental station at 0-10 cm. depth from Jan to Dec. 94.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	89.5	89.9	88.8	89.1	89.5	89.0	88.90
31 Jan	88.9	89.0	88.4	89.2	89.5	88.8	
14 Feb	87.1	87.5	87.7	86.9	87.3	87.3	85.35
28 Feb	83.3	83.7	83.3	83.6	83.1	83.4	
15 Mar	75.0	74.9	75.1	75.3	75.7	75.2	70.85
31 Mar	66.6	66.8	66.9	66.3	65.9	66.5	
15 Apr	51.9	51.7	51.4	51.8	51.2	51.6	48.70
30 Apr	45.6	46.0	46.1	45.9	45.4	45.8	
15 May	40.5	30.2	39.7	39.8	40.8	40.2	39.95
31 May	39.8	40.0	39.3	40.1	39.3	39.7	
15 Jun	36.5	37.3	37.1	36.6	36.5	36.8	46.55
30 Jun	56.9	55.9	56.0	56.5	56.2	56.3	
15 Jul	86.6	86.9	86.5	87.2	87.3	87.1	86.50
31 Jul	86.3	85.9	85.8	86.4	85.1	85.9	
15 Aug	81.9	81.5	82.2	82.0	82.4	82.0	81.85
31 Aug	82.1	81.5	81.4	81.5	82.0	81.7	
15 Sep	82.5	82.9	83.5	82.1	83.0	82.8	83.55
30 Sep	84.1	84.4	84.1	84.3	44.6	84.3	
15 Oct	78.3	77.7	77.6	78.3	78.1	78.0	77.90
31 Oct	77.3	78.1	78.2	78.1	77.3	77.8	
15 Nov	74.8	75.6	75.1	75.9	75.6	75.4	79.50
30 Nov	83.4	84.1	83.7	83.8	83.0	83.6	
15 Dec	80.7	81.2	81.0	80.8	81.3	81.0	83.60
31 Dec	85.6	85.9	86.4	86.6	86.5	86.2	

Table XVII

Fortnightly variation in R.H. (in percent) at five experimental station at 10-10 cm. for Jan to Dec. 94.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	89.6	90.3	89.9	89.5	89.7	89.8	89.70
31 Jan	89.8	89.6	89.6	89.1	89.9	89.6	
14 Feb	87.9	88.5	87.7	88.3	88.6	88.2	87.15
28 Feb	84.8	87.7	84.9	85.5	85.6	85.1	
15 Mar	78.3	78.2	78.6	78.8	78.9	78.6	72.90
31 Mar	66.9	67.5	66.7	66.7	67.2	67.2	
15 Apr	56.6	56.9	56.8	56.7	56.5	56.7	52.10
30 Apr	47.1	87.7	47.9	47.4	47.4	47.5	
15 May	41.0	40.9	41.5	41.9	41.2	41.3	42.85
31 May	44.0	44.7	44.6	44.5	44.2	44.4	
15 Jun	34.6	35.1	34.3	34.9	35.1	34.8	44.20
30 Jun	53.6	53.5	53.9	53.7	53.6	44.2	
15 Jul	84.4	83.5	85.4	84.4	84.2	84.2	85.10
31 Jul	86.2	86.5	86.1	85.3	85.9	86.0	
15 Aug	82.2	82.6	82.5	81.7	82.5	82.3	83.40
31 Aug	84.5	84.9	84.7	84.1	84.3	84.5	
15 Sep	82.5	82.9	83.5	82.4	82.2	82.7	83.25
30 Sep	83.5	83.7	83.9	83.9	84.0	83.8	
15 Oct	79.9	79.5	79.2	94.4	80.0	79.6	79.25
31 Oct	78.4	78.6	79.3	79.2	79.20	79.9	
15 Nov	77.6	79.9	77.3	78.6	77.2	77.4	79.60
30 Nov	81.9	82.1	82.3	81.3	81.4	81.8	
15 Dec	82.2	82.4	82.9	83.0	82.3	82.7	83.60
31 Dec	85.1	84.7	84.4	84.3	84.0	84.5	

Table XVIII

Fortnightly variation in R.H. (in percent) at five experimental station at 20-30 cm. for Jan to Dec. 94.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	90.1	89.9	90.4	90.9	90.7	90.4	90.25
31 Jan	89.6	90.0	90.4	90.4	90.1	90.1	
14 Feb	89.5	89.1	89.7	89.9	89.3	89.3	87.90
28 Feb	86.3	86.6	86.2	87.0	86.4	86.5	
15 Mar	78.9	78.9	78.7	78.6	77.9	78.6	73.20
31 Mar	68.4	68.0	67.5	68.0	68.1	67.8	
15 Apr	56.2	56.1	56.0	56.9	56.3	56.3	51.85
30 Apr	47.7	46.9	47.6	47.1	47.7	47.4	
15 May	41.7	41.4	41.4	41.7	41.3	41.5	42.75
31 May	43.8	83.5	44.4	44.1	44.3	44.0	
15 Jun	37.5	37.4	37.3	38.1	37.7	37.6	46.25
30 Jun	54.7	55.3	54.8	55.1	54.6	54.9	
15 Jul	84.5	84.7	85.1	85.4	85.3	85.0	86.15
31 Jul	87.1	87.9	87.0	87.2	87.3	87.3	
15 Aug	86.3	86.4	86.3	86.6	86.0	86.1	87.40
31 Aug	88.6	88.5	89.1	89.0	88.3	88.7	
15 Sep	85.6	84.8	85.8	85.4	85.4	85.4	85.10
30 Sep	84.6	85.1	85.2	84.7	84.4	84.8	
15 Oct	79.9	80.0	80.5	80.0	80.6	80.2	80.05
31 Oct	79.5	79.9	79.9	80.0	80.2	79.9	
15 Nov	78.3	78.1	77.4	77.2	78.0	77.8	80.05
30 Nov	82.5	82.6	82.6	82.2	82.6	82.3	
15 Dec	83.9	83.3	83.1	83.7	84.0	83.6	84.65
31 Dec	85.5	86.1	86.0	86.4	86.5	85.7	

PLATE 41

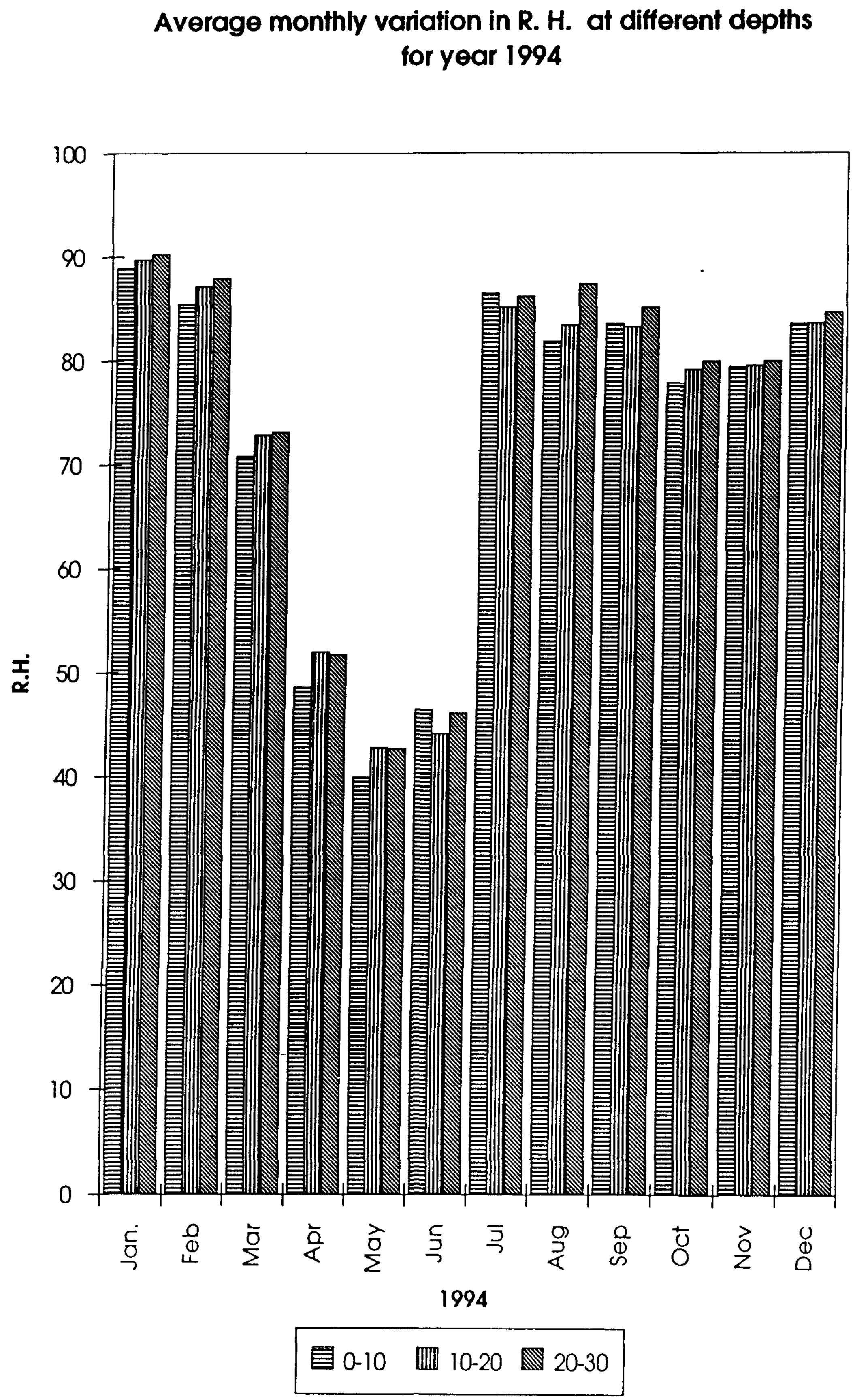


FIG. - 85

Table XIX

Fortnightly variation in vertical distribution of <u>Tylenchorhynchus</u> recovered from 250 ml Soil 0-10 cm. depth, at five experimental station from Jan to Dec. 94.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	8.56	935	925	844	891	890	917
31 Jan	947	903	985	910	980	945	
14 Feb	1200	1180	1245	1225	1175	1205	1245
28 Feb	1370	1200	1300	1250	1305	1285	
15 Mar	1442	1300	1378	1370	1365	1371	1523
31 Mar	1656	1696	1595	1710	1726	1676	
15 Apr	1851	1911	1885	1830	1925	1881	1953
30 Apr	2025	2050	1950	2005	2095	2025	
15 May	700	765	731	716	759	731	677
31 May	630	600	643	580	687	624	
15 Jun	570	530	626	590	549	573	558
30 Jun	522	566	548	500	584	544	
15 Jul	657	607	640	684	798	657	689
31 Jul	721	781	701	691	711	721	
15 Aug	1020	1000	1063	975	1082	1028	982
31 Aug	936	910	962	880	992	936	
15 Sep	1141	1201	1175	1065	1237	1171	1230
30 Sept	1292	1240	1338	1305	1275	1290	
15 Oct	1756	1736	1761	1678	1799	1746	1787
31 Oct	1839	1819	1801	1864	1822	1829	
15 Nov	1936	1900	1974	1882	2036	1938	2042
30 Nov	2142	2101	2163	2170	2134	2147	
15 Dec	920	895	901	1014	820	910	947
31 Dec	935	1045	1000	960	985	985	

Table XX

Fortnightly variation in vertical distribution of Tylenchorhynchus recovered from 250 ml Soil of 10-20 cm. depth at five experimental station from Jan to Dec. 94.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	920	1010	970	985	940	965	998
31 Jan	1050	1014	1030	1002	1064	1032	
14 Feb	1220	1368	1294	1310	1278	1294	1340
28 Feb	1360	1404	1341	1420	1400	1387	
15 Mar	1631	1600	1662	1650	1614	1631	1726
31 Mar	1823	1780	1800	1842	1860	1821	
15 Apr	2073	2010	2100	2090	2093	2073	2219
30 Apr	2368	2340	2392	2350	2365	2365	
15 May	987	1000	974	992	982	987	841
31 May	701	689	610	747	698	695	
15 Jun	672	580	764	690	654	672	641
30 Jun	610	625	595	600	620	610	
15 Jul	787	710	829	807	802	787	861
31 Jul	938	900	974	950	918	936	
15 Aug	1080	1056	1000	1136	1068	1068	115
31 Aug	1242	1210	1274	1092	1192	1242	
15 Sep	1373	1300	1402	1350	1435	1373	1409
30 Sep	1446	1410	1484	1455	1430	1445	
15 Oct	2038	2000	2010	2028	2019	2019	2108
31 Oct	2190	2204	2167	2187	2237	2197	
15 Nov	2294	2276	2236	2256	2266	2286	2287
30 Nov	2480	2494	2501	2420	2545	2489	
15 Dec	1016	1032	1000	1084	1024	1032	991
31 Dec	950	975	925	1000	900	950	

Table XXI

Fortnightly variation in vertical distribution of Tylenchorhynchus recovered from 250 ml Soil of 20-30 cm. depth of five experimental station from Jan to Dec. 94.

Date & Month	A	B	C	D	E	Average	Monthly Mean
15 Jan	655	615	600	675	630	635	603
31 Jan	550	564	585	510	621	572	
14 Feb	517	507	530	544	462	512	599
28 Feb	694	680	637	707	717	687	
15 Mar	795	785	740	810	820	790	877
31 Mar	970	958	932	996	964	964	
15 Apr	1075	1067	1050	1085	1080	1071	1102
30 Apr	1135	1020	1161	1249	1100	1133	
15 May	735	702	781	726	761	741	691
31 May	652	672	640	700	706	682	
15 Jun	315	290	369	228	288	318	324
30 Jun	341	321	362	331	300	331	
15 Jul	429	400	456	475	380	428	505
31 Jul	580	510	550	668	602	582	
15 Aug	649	653	691	661	601	651	670
31 Aug	692	688	702	678	690	690	
15 Sep	742	738	765	715	740	740	758
30 Sep	770	764	775	700	849	777	
15 Oct	809	827	840	800	814	818	854
31 Oct	890	870	810	910	970	890	
15 Nov	1035	1000	1062	1030	1038	1031	1090
30 Nov	1152	1048	1210	1180	1140	1150	
15 Dec	801	700	734	750	740	745	677
31 Dec	615	625	600	665	640	610	

PLATE 42

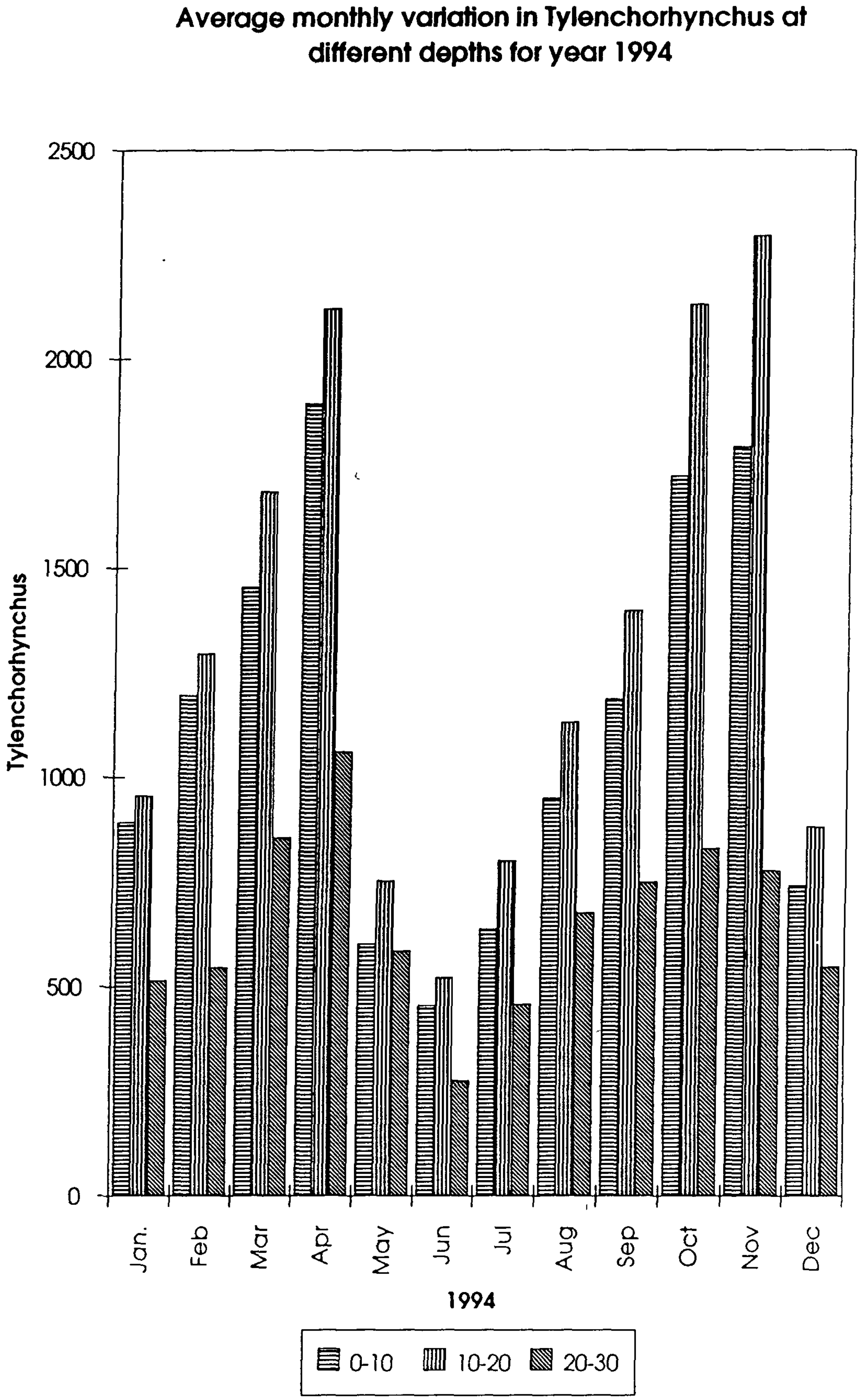


FIG. - 86

Table XXII

Seasonal fluctuation in the population, 1993

Tylenchorhynchus recovered from 250 ml soil at depth (in cm.)

Months	0-10	10-20	20-30	Total
Jan	1735	1913	1031	4679
Feb	2390	2592	1095	6077
Mar	2911	3368	1712	7991
Apr	3782	4245	2220	10247
May	1206	1508	1174	3888
Jun	916	1047	552	2515
Jul	1278	1605	921	3804
Aug	1905	2167	1457	5929
Sep	2377	2804	1503	6684
Oct	3444	4247	1663	9354
Nov	3582	4591	1955	10128
Dec	1486	1766	1100	4352
Total	27012	31853	16283	75148

Table XXIII

Seasonal fluctuation in the population, 1994
Tylenchorhynchus recovered from 250 ml soil at depth
(in cm.)

Months	0-10	10-20	20-30	Total
Jan	1835	1997	1207	5039
Feb	2490	2681	1199	6370
Mar	3047	3452	1754	8253
Apr	3906	4438	2204	10548
May	1355	1602	1423	4380
Jun.	1117	1282	649	3048
Jul	1378	1723	1010	4111
Aug	1964	2310	1341	5615
Sep	2461	2818	1517	6796
Oct	3575	4216	1708	9499
Nov	4085	4775	2181	11041
Dec	1895	1982	1395	5232
Total	29108	33276	17548	79932

PLATE 43

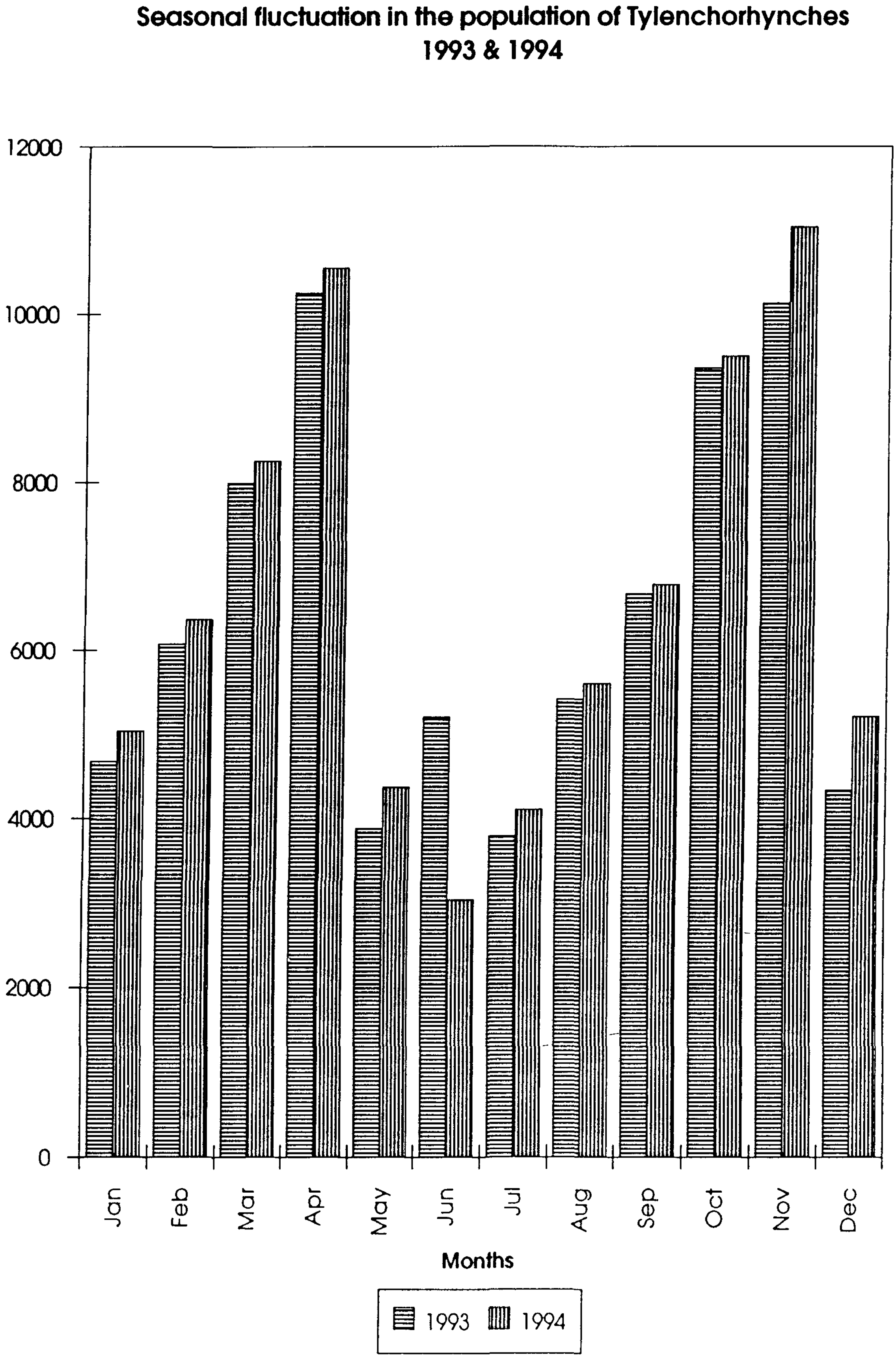


FIG. - 87

Table XXIV

Number of males females juveniles in different crops (all depths combined) 1993-94

Crop	Month of sampling	Male	Female	Juvenile	Total
Maize (1993)	Jul	52	205	645	902
	Aug	56	225	875	1156
	Sep	60	235	915	1210
	Oct	35	94	280	409
Wheat (1993-94)	Nov	38	98	292	428
	Dec	74	294	715	1083
	Jan	80	321	948	1349
	Feb	95	388	1026	1509
	Mar	112	423	1192	1727
	Apr	125	461	1235	1821
Cow-pea (1994)	May	26	90	235	351
	Jun	24	83	175	282
	Total	777	2917	8533	12227

PLATE 44

Number of Male, Female and Juvenile in different crops (all depths combined) 1993-94

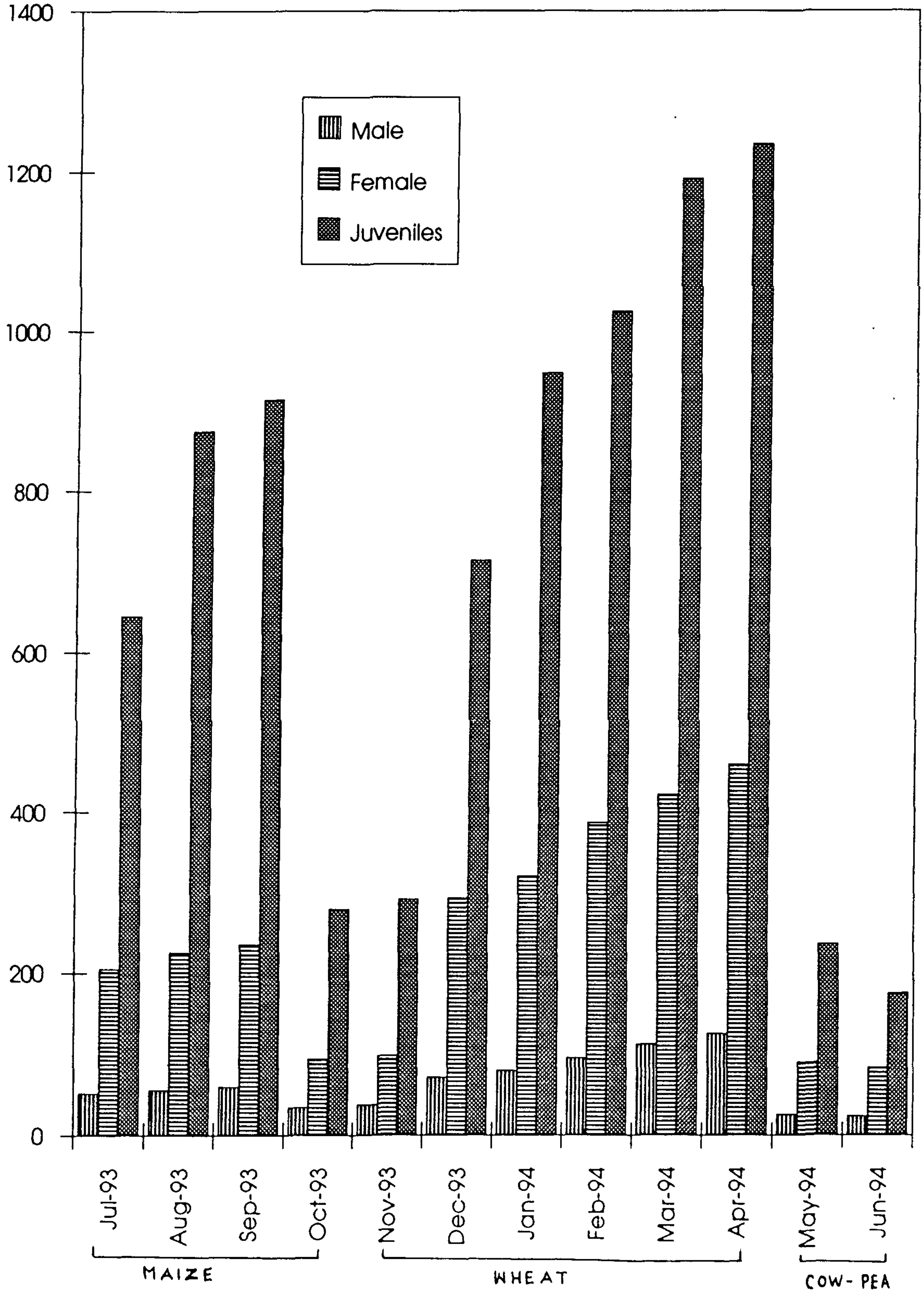


FIG. - 88

DISCUSSION

The present study reveals that high temperature and low humidity during the month of April appeared to be conductive and optimum for multiplication of the nematodes. Further rise in temperature and fall in relative humidity might have decreased their tolerance to desiccation, resulting in a fall in the population. Similar findings were recorded by Wallace (1963) in respect of root-knot nematode. The maximum population of females coincides with the fall on the population of males. The population peak of the larvae was also observed during the same fortnight ending of the 30th April 1993 and 1994. Increase in the temperature might have stimulated hatching of eggs in the field which accounts for the stable population or larvae. Bishop (1953) and Wallace (1955) while working on *Heterodera* cysts found similar results. Lower population during water months and higher during warmer months is in coincidence with the findings of Bishop (1953) with the *Heterodera rostochiensis*.

The temperature, humidity and rainfall may also be contributing to the population fluctuation of nematodes. The author recorded two peaks of the nematodes one at 17-23°C and other 28-32°C soil temperature. The study indicates that the rate of reproduction of _Tylenchorhynchus_ is increased between 17-23°C and 28-32°C soil temperature at all vertical depths. Siddiqi _et al_. (1973) reported an increased population growth of _Tylenchorhynchus brassicae_ around cauliflower and cabbage between 25-30°C soil temperature. Khan _et al_. (1971) did not find any definite correlation in the population of _Hoplolaimus_ sp. and _Helicotylenchus_ sp. around the _Magnifera indica_ with soil temperature.

Baghel and Bhatti (1982) studied the effect of soil temperature on population fluctuation in a combind population of eight plant nematode species and observed that the soil temperature between 29.0-34.2°C was unfavourable for growth of total nematode population. No statistical inference have been drawn to establish correlation of soil temperature and population fluctuations in phytonematode densities in the above study. The author, therefore, wish to emphasize on the basis of sound statistical interpretation, that the growth of population of _Tylenchorhynchus_ sp. is favoured between 17-32°C soil temperature. Griffin and Darting (1964) observed that the soil nematode population increased at coller temperature.

The second peak of nematode density obtained in this investigation at relatively lower temperature (17-23°C) is also in conformity with the observation of Pervina et al. (1974). Reconding high peaks of Ditylenchus dipsaci around 12°C of soil temperature. Norton (1978) also observed the role of soil temperature as a mojor factor limiting the population of nematodes. It has been argued that extremes of temperature may be inhibitory for the growth of nematode population and survival is best at moderate temperature. The present investigation is further in close conformity with the above findings.

There is not much information on the seasonal fluctuations in the distribution pattern of Tylenchornynchus sp. under natural conditions. The influence of season on the soil nematode was more evident at 0-10 cm depth than the deeper layer of soil. There are two nematode peak-one in April and second peak in November in his investigation. The highest peak recorded in April whereas Khan et al. (1971) working on Hoplolaimus indices around Magnifera indicus found highest population in October-November, Srivastava and Sethi (1986) shows two peaks of certain nematode species, in March-April and October-November. Similar seasonal peaks were reported by Mukhopadhyay and Prasad (1968) for Tylenchonlynchus; Griffin and Darling (1964) for Xiphinema americanum; Winslow (1964) for Tylenchida and Yuen (1966) for Helicotylenchus vulgaris.

The recovery of Tylenchorhynchus from maize, wheat, Cow-pea and some other crops for different soil depths demonstrates not only that the genera is polyphagous but it also indicates that their distribution is mainly restricted between 10-20 cm soil zone corresponding probably to the zone of distribution of tertiary roots. Yush (1966) and Mukhopadhyaya and Prasad (1968, 1969) pointed out that the vegitation cover and most distribution influence the vertical distribution. The adults of this genera were abundant in the 10-20 cm layer. Similar results were obtained by Hoff and Mai (1964) for Trichodorus christrai; by Zuckarman, Khera and Pierce (1964) for Hemicychiophara similis; by Mukhopadhyaya and Prasad (1969) for Pratylenchus sp. Hoplolaimus sp. & Heliocotylenchus sp. and Richter (1969) for Tylenchorhynchus and Pratylenchus.

The nematodes has a seasonal rhythm with minima in winter and summer and maxima in spring and autumn. These peaks were clearly visible for the depth

0-10 and 10-20 cm and less obvious at 20-30 cm layer. Host crops seem to affect prevalence of this genus because seasonal peaks of *Tylenchorhynchus* correspond to the stage of maximum growth of host crop viz the *Rabi* (Winter) crops are at maturity during March-April and Kharif (Summer) crop during October-November. Thus seasonal effects were confounded with the stages of crop growth. Yuen (1966) and Mukhopadhyaya and Prasad (1968, 1969) obtained similar results in case of various nematodes.

CHAPTER XVII

SUMMARY

SUMMARY

The thesis embodies the results of the survey of Rewa district for Animal and plant parasitic nematodes carried out by the author during the session 1993-1994. The animal parasitic nematodes were collected from the Fishes, Amphibia, Reptilia and Mammals. The survey of one hundred six animal host of twenty three species belonging three species of fishes, three amphibia, seven repitles, six birds and four mammals were performed.

The plant parasitic nematodes were recovered from 250 ml soil and root samples of common vegetable, cereal and ornamental plants. The host plants belonging to five families of Moncotyledons, Eighteen families of Dicotyledons and two families of non-flowering plants. In all twenty six genera and twenty nine species of host plants were surveyed.

Several known and unknown forms of animal and plant parasitic nematodes were obtained from these hosts. But only three new forms and two old forms from animal and from the plant only five new forms and two old forms have been described in the thesis.

SECTION - A

ANIMAL PARASITIC NEMATODES

Section A deals with the Nematodes parasites of Fishes, Amphibia, Reptiles, Aves and Mammals.

ORDER - SPIRURIDEA Deising, 1961

Family - Camallanidae Railliet et Henry,1915

Genus - Procamallanus, Baylis, 1923.

Procamallanus chauhanensis n.sp. has been described from stomach of *Mystus seenghala* collected from the Lalpa Talab Rewa.

Genus - Camallanus Railliet et Henry, 1915 Syn. Cucullanus Auctt, nec. Mueller, 1777.

Camallanus thaparansis n.sp. has been recovered from intestine of *Rana cynaphlectis* collected from the river Tomus at Chakghat Rewa.

ORDER - ASCARIDIDEA n.ord. For Ascaroidea Railliet et Henry, 1915

Family - Ascarididae Blanchard, 1849

Sub family - Ascaridinae Wane,1922 For Ascarinae Travassos, 1913.

Genus - Ophidascaris Baylis, 1921.

Ophidascaris ajgaris Khera, 1956 has been redescribed from the body cavity of *Python molurus* collected from the campus of Govt. Model Science College, Rewa.

ORDER - SPIRURIDEA Diesing, 1861

Family	-	Thelaziidae Skrjabin, 1915
Subfamily	-	Oxyspirurinae Skrjabin, 1916
Genus	-	Oxyspirura Drasche in Stoss, 1897

Oxyspirura mehransis n.sp. has been described from the intestine of *Bubulcus ibis* (Linn.) collected from Housing Board Colony, Bodabag, Rewa.

ORDER - STRONGYLIDEA Diesing, 1851

Family	-	Ancylostomatidae Nicoll, 1927
Subfamily	-	Bunostominae Loss, 1911 Syn. Necatorinae Lane, 1917.
Genus	-	Arthocephalus Ortlepp, 1925.

Arthocephalus herpestis Khera, 1956 has been redescribed from intestine of *Herpestis smithii smithii* collected from the Kuthulia farm, Rewa.

SECTION - B

PLANT PARASITIC NEMATODES

Section "B" deals with the nematode parasites of plants viz. vegetable, fruit, Doob grass and ornamental plants.

ORDER - TYLENCHIDA (Filipjev, 1934) Thorne, 1949

Family	-	Tylenchidae Orley, 1880
Subfamily	-	Tylenchinae (Orley, 1880) Marcinowski, 1909
Genus	-	Tylenchus Baston, 1865

Tylenchus rewansis n.sp. has been described from soil arround the rhizosphere of Lady finger, *Abelmoschus esculentus*, collected from Teonther, Rewa.

Family	-	Tylenchorhynchidae (Eliava, 1964) Golden, 1971.
Subfamily	-	Tylenchorhynchinae Eliava, 1964.
Genus	-	*Tylenchorhynchus* Cobb, 1913.

Tylenchorhynchus indicus n.sp. has been described from the soil arround the root and inside root of Garden Croton, *Codiaeum Variegatum*. Collected from Bajrang Nagar, Rewa.

Family - Pratylenchidae (Thorne, 1949) Siddiqi, 1963

Subfamily - Pratylenchinae Thorne, 1949

Genus - Pratylenchus Filipjev, 1936

Pratylenchus thornensis n.sp. has been described from the rhizosphere of Papaya, Cariea papaya Linn. collected from civil lines Rewa.

Family - Hoplolaimidae (Filipjev, 1934) Wieser, 1953

Subfamily - Hoplolaiminae Filipjev, 1934

Genus - Hoplolaimus Daday, 1905

Hoplolaimus indicus Sher, 1963 has been redescribed from the soil arround the root of Bean, Dolichos lablab, from Agriculture College Rewa.

Subfamily - Rotylenchinae, Golden, 1971

Genus - Helicotylenchus Steiner, 1945

Helicotylenchus jenkinsis n.sp. has been described from root of Doob grass, Cynodon dactylon Pers from Chirahula Colony Rewa.

ORDER - APHELENCHIDA Siddiqi, 1980

Family - Aphelenchoididae (Skarbilovich, 1940) Paramonov, 1953

Subfamily - Seineurinae (Husain & Khan, 1967) Baranovskaya, 1981

Genus - Seineura, Fuchs, 1931

Seineura sasseris n.sp. has been described from the rhizosphere of Brinjal, *Solanum melongana* Linn. collected from Indra Nagar Rewa.

ORDER - DORYLAIMIDA (de Man, 1876) Pearse, 1942

Family	-	Longidoridae (Thorne, 1935) Meyl, 1961
Subfamily	-	Xiphinematinae Dalmasso, 1969
Genus	-	*Xiphinema* Cobb, 1913

Xiphinema basiri Siddiqi 1959 has been redescribed from the soil arround the root of Bougainvillea, *Bougainvilea* sp. collected from Ratahara Rewa.

SECTION - C

Bio-ecology

Section "C" deals with the Bio-ecology of <u>Tylenchorhynchus</u> sp. The biology of the genus has been studies at room temperature and relative humidity in the month of september and October.

The gravid femals were collected from the suspension of potted maize soil. During ovipositon, the female body become curved into "C" shape.

The eggs were laid in single cell stage with prominent nucleus at centre having kidney shape.

The first cleavage was transverse and the second too, transversely opposite to the first. The fourth cleavage was longitudinal.

At the stage of gastrula the cells are arranged in a sequence with transparent areas. The tadpole seen 4-5 days after oviposition.

The first juvenile stage appeared 4-5 days after oviposition. The head end of embryo, broad, truncated, and hyaline. The tail slightly narrow, bluntly rounded and hyaline at the distal end.

The second juvenile move vigorously inside the egg shell before emergence and pierced the vitelline membrane with the help of stylet, releasing the juvenile.

The third and fourth juvenile increased in length considerably with the growth of different parts of body and thus completing the life cycle in 28-35 days.

For the study of ecology of Tylenchorhynchus two main factors, temperature and relative humidity were selected having maize-cowpea and Wheat rotation under field condition.

The Tylenchorhynchus exhibite two peaks - one at 17-23°C and other at 28-32°C soil temperature at all depths. The population at lower soil temperature was invariably higher than that of higher soil temperature.

The study of soil relative humidity indicates that the population of Tylenchorhynchus increase at 45-52 and 79-80 RH in all the depths. The high population of nematodes was recovered at low soil moisture condition.

The distribution of Tylenchorhynchus in the soil having host crops was restricted mostly on 0-10 cm and

10-20 cm soil zone. The juveniles were generaly found in the 0-10 cm and 10-20 cm layer. The females are nearly four time more than males but three time less than juveniles.

The number of nematodes increases during February to April and in September-October and decreases during December-January and June to August.

The maximum nematodes recovered from 0-10 cm depth during March and April. The increase in the upper layer was mainly due to increase in juvenile population.

The increase in the adult population was noticeable from the recovery made from 10-20 cm layer.

There is not much information on seasonal fluctuations in the distribution pattern of *Tylenchorhynchus* under natural condition. The influence of season on soil nematode was more evedent at 0-10 cm depth that deeper layer. There are two peak-one in April and second in November in this investigation.

The recovery of *Tylenchorhynchus* from different species of host plant from various soil depths indicated that the genera is not only polyphagous but it also demonstrate that their distribution is mainly restricted between 10-20 cm soil zone corresponding probably to the zone of distribution of tertiary roots.

The nematodes had a seasonal rhythm with minima in winter and summer and maxima in spring and autumn. The seasonal peaks of Tylenchorhynchus correspond to the stage of maximum growth of host crop viz the Rabi (Winter) crops are at maturity during March-April and Kharif (Summer) crop during October-November. Thus seasonal effects were confounded with stage of crop growth.

BIBLIOGRAPHY

REFERENCES

Agrawal, M.P. 1930. A new nematode Procamallanus mehrii n.sp. form a local siluroid fishwallago attu. Allahabad Univ. Studies 6(2), Sc. Sect., 59-64.

Ali, S.M. 1956. Studies on the nematode Parasites of fishes and birds found in Hyderabad State. Ind. Jour. Helminth. 8:1-83.

Basir, M.A. 1937. Cyathostoma phenisci n.sp., Parasite de la trachee d' Un Pingouin. Ann. Par. 15(3), 218-224.

Basir, M.A. 1939. Necator Suillus Ackert Und Payne, 1922. Zool. Anz., 127 (7-8), 222-223.

Basir, M.A. 1940. The Experimentelle Infektionen von Ratten Und Mausen mit Trichinen. Ztschr. Infektionskr. Haustiere, 56(2), 145-151.

Basir, M.A. 1949. On a larval nematode from an insect with a note on the genera Thubunaea Seurat, and Physalopteroides Wu and Liu, 1940, J. Par. 35(3), 301-305.

Bastian, N.C. 1863. On the structure and nature of the Guinea-worm. Trans. Linn. Soc., 24, 101-134.

Baylis, H.A. 1936. Some Parasitic Worms for the British Cameroons. Ann. & Mag. Nat Hist., (10), 17(98), 257-272.

Baylis, H.A. 1939. The fauna of British India, including Ceylon and Burma. nematoda. Vol. II. 1-274. London.

Baylis, H.A. and Daubney, R. 1926. A Synopsis of families and genera of nematoda. 277 pp.

Bhalerao, G.D. 1931. Two new parasites from the King Cobra (Najahannah). - Ann. & Mag. Nat. Hist. (10), 8, 102-109.

Bhalerao, G.D. 1932. On some Nematode Parasites of Goats and Sheep at Muktesar. Ind. Jour. Vet. Sci. Anim. Husb., 2(3), 242-254.

Bhalerao, G.D. 1933. On a few Nematodes Parasitic in Goats at Muktesar. Ind. Jour. Vet. Sci. & Anim. Husb., 3, 163-165.

Bhalerao, G.D. 1934. On the Nematode causing stomach tumours of the Indian Crocodile, *Crocodilus Palustris*. Ind. Jour. Vet. Sci. & Anim. Husb., 4, 247-252.

Bhalerao, G.D. 1935. Helminth Parasites of the Indian Elephant from the Andamans and Burma - Ind. Jour. Vet. Sci. & Anim. Husb., 5, 1-14.

Bhalerao, G.D. 1941. *Subulura minetti*. n.ap. (Nematoda) from and India fowl. - Proc. Ind. Acad. Sci., 14(3), 339-340.

Bhalerao, G.D. & Rao, N.S.K. 1944. Some helminth parasites of Poultry. - Proc. Ind. Acad. Sci., Sect. B. 20(1), 30-39.

Boulenger, Ch.L. 1921. On some Filariid Parasites of Cattle and other ruminants. Parasit. 12(4), 341-349.

Chakravorty, G.K. 1936. On a nematode from calotes versicoloy. Proc. 23. Ind. Sc. Cong. p. 347.

Chakravorty, G.K. 1942. A new Nematode Camallanus Salmonae from Kashmir. Curr. Sci., 11(11), 441-442.

Chakravorty, G.K. 1939. On a nematode, Pseudaspidodera jnanendrae n.sp. from the Pea-fowl (Pavo Cristatus). - Parasit., 30(2), 167-170.

Chakravorty, G.K. 1939. On the Nematode Camallanus anabantis Pearse. - Sci & Culture. 5(5), 317-318.

Chakravorty, G.K. and Bhaduri, N.V. 1948. An Oxyurid nematode Neopharyngodon gekko gen. et sp. Nov. Form the Indian Lizard, Gecko Gecko (Linn.) - Proc. Zool. Soc. Bengal. 1(2), 107.

Chatterji, R.C. 1933. On a new Nematode, Parapharyngodon Maplestoni, gen nov., sp. nov., form a Burmese Lizard. Ann. Trop. Med Parasit., 27, 131-134.

Chatterji, R.C. 1935. Nematode from a common Indian Lizard (Uromastix hardwickii) with remarks on Kalicephalus Parvus Maplestone 1932 - Rec. Ind. Mus. 37, 29-36.

Chatterji, R.C. 1936. On a new species of nematode Amplicaecum cacopi sp. nov., from Cacopus Systoma - Ann. Trop Med Parasit., 30(1), 41-44.

Chandler, A.C. 1925. The Helminthic Parasites of Cats in Calcutta and the Relation of Cats to human helminthic infections. - Ind. Jour. Med. Res., 13, 13-227.

Chandler, A.C. 1926-28. The Prevalence and Epidemiology of Hook worm and other Helminthic infections in India - Ind. Jour. Med. Res.,

Chandler, A.C. 1929. Some new genera and species of Nematode worms, Filarioidea, from Animals dying in the Calcutta Zoological Garden Proc. U. S. Nat, Mus., 75 Art. 6, 1-10.

Diesing, K.M. 1950. Systema Helminthum, Berlin, Vol. 2, 588 pp.

Dujarding, F. 1845. Histoire naturelle des Helminthes Ou Vers intestinaux. Pairs. XVI+ 654 + 15 pp.

Eberth, C.J. 1863. Untersuchungen iiber Nematoden. Leipzig, 77 pp.

Gaiger, S.H. 1911. Notes on Parasites. J. Trop. Vet. Sc. 6(3), 292-296.

Goodey, T. 1933. Plant parasitic nematodes and the diseases they cause. Methuen, London, 306 pp.

Karve, J.N. 1927. A new Nematode from Burmese Tortoise, Testudo emys. Ann. Trop. Med Parasit., 21, 343-350.

Karve, J.N. 1928. On a new species of the Nematode genus Spiroxys with a key to the species and their host distribution - Ann Trop. med. Parasit., 22(2), 267-272.

Karve, J.N. 1930. Some Parasitic nematodes of Frog and toads. - Ann. Trop. Med. Parasit., 24(4), 481-491.

Karve, J.N. 1934. Two new species of the genus Diplotriaena (Nematoda) Parasitic in the common Indian Myna, Acridotheres tristis tristis - Jour Univ. Bombay, 2(5), 75-81.

Karve, J.N. 1938. Some Nematode Parasites of Lizard. Livro Jub. Prof. Travassoa. 251-258.

Karve, J.N. 1941. Some Parasitic Nematodes from Anura. - Proc. Ind. Acad. Sci. 19(3), 71-77.

Karve, J.N. 1941. On a small collection of Parasitic Nematodes from Anura - Proc. Ind. Acad. Sci., 19(3), 71-77.

Khera, S. 1951. A new nematode Micropleura indica n.sp. belonging to the family Philometridae Baylis and Daubney, 1926 from the Ganges tortoise. Trionyx gangeticus Cuvier Indian J. Helm. 3(1), 55-58.

Korke, V.T. 1924. On a new Microfilaria from the dog., Microfilaria lewisii (n.sp.), - Ind. Jour. Med. Res. 11, 1231-1238.

Lal, M.B. 1942. The occurrence of the nematode genus Oswaldocruzia in India. Curr. Sci. 11(8), 345.

Lal, M.B. 1944. A new amphibian Tricho - Strongylata from Swine. - Ann. & Mag. Nat. Hist., (9) 9, 683-685.

Lane, C. 1913. Agchylostoma Ceylanicum, a new human Parasite. Ind., Gazette, 48(6), 217-218.

Lane, C. 1921. Some bursate nematodes from Indian and African elephants. Ibid. 9(1), 163-172.

Leuckart, K.G.F.R. 1865. Bericht Uber die Wissenschaftlichen Leistungen in der Naturgeschichte der niederen Thiere wahrend der Jahre 1864 Und 1865 (Erste Halfte). ibid. 31. J. 2, 165-268.

Linnaeus, C. 1758. Systema natuare Per regna tria naturae Secundum Classes, ordines, genera, species, cum characteribus, differentitiis, synonymis, locis. Editio decima, reformata, Vol. 1, 823 pp. Halmiae.

Liennaeus, C. 1967. Idem. Editio duodecima, reformata, Vol. 1 pp. 533-1327.

Maplestone, P.A. 1930. Nematode Parasites of Pigs in Bengal. Rec. Ind. Mus., 32, 77-105.

Maplestone, P.A. 1932. Parasitic Nematodes obtained from Animals dying in the Calcutta Zoological Gardens. Pts. 9-11. - Ind. Mus., Rec. Ind. Mus. 34, 229-261.

Mirza, M. 1933. On a new Nemathelminth from Herpestes mungo. - Zeits. Parasitenk., 6, 638-641.

Mirza, M. 1934. Sciurus Palmarum als ein interessanter Writ Von Physaloptera sp.- Zeits. Parasitenk., 6, 638-641.

Mirza, M. 1935. Physaloptera achari n.sp. from calotes versicolor, with a short note on abnormalities in the genus Physaloptera. Proc. Acad. Sci. (U.P., India), 5, 71-74.

Mirza, M. 1936. Subulura hindi n.sp. A new nematode parasite of Sciurus Palmarum. - Proc. Ind. Acad. Sci., 3(2), 125-127.

Moorthy, V.N. 1937. A Redescription of Dracunculus medinensis. - Jour. Parasit., 23, 220-224.

Moorthy, V.N. 1938. Spinitectus Corti n.sp. (Nematoda ; Spiruridae) - Jour Parasit., 24(4) 319-322.

Pandit, C.G. Pandit, S.R. and Iyer, P.V.S. 1929. A new Filaria in Calotes Versicoloyconispiculum guindiensis n.g. n.sp. Proc. 16. Indian Sc. Cong. 317; Ind. J. Med. Res. 16(4), 954-958.

Patwardhan, S.S. 1935. Nematodes from the common wall lizard, Hemidactylus flavovirides (Ruppel). Proc. Ind. Acad. Sc. 1(7), Sect. 13, 376-38.

Rahimullah, M. & Das, B.K. 1933. On Certain Helminth Parasites from Chandrabora" - Russel's Viper (Vipera russelli) - obtained from the Nizam's dominions. - Curr, Sci., 2, 275-276.

Roy Chaudhuri, G.N. 1931. Eustrongylus gigas in the kidney of a great dane dog. - Ind. Vet. Jour., 8, 45-46.

Rudolphi, C.A. 1819. Entozoorum Synopsis cui accedunt mantissa duplex et indices locupletissini X + 811 pp. Berolini.

Sanwal, K.C. 1951. On a new Avian Nematode, Dispharynx Pavonis n.sp. (Sub-family Acuariinae Railliet, Henry & Sisoff, 1912) from the Pea-Fowl, Pavocristatus. Ind. Jour. Helminth., 3(2), 73-78.

Sarwar, M.M. 1944. Some new records of the nematode worms from Indian runinants. - Ind. Jour. Vet. Sci. & Anim. Hush., 14(1), 6-60.

Sarwar, M.M. 1945. Two new records and a New Species of the genus Trichuris from Domestic Ruminants. - Curr. Sci., 14(4) 306-307.

Sarwar, M.M. 1946. A new species of genus Trichuris from Cattle and Buffaloes. - Curr. Sci., 15(2), 52-53.

Schneider, A.F. 1866. Monographie der Nematoden, Berlin. Xiii + 35 pp.

Sheather, A.L. 1919. A new Nematode Causing Parasitic Gastritis in Calves - Agr Res. Inst. Pusa Bull. No. 86, 1-5.

Singh, S.N. 1934. Gastronodus Strassenil n.et. sp.n. A. new Nematode Parasitic of Crocidura coerulea - the common Musk-Shrew or, as it usually called Musk-Rat (Vernacular : Chachudar). - Curr. Sci. 2, 287.

Singh, S.N. 1948. Studies on the Helminth parasites of birds in Hyderabad State. Nematoda I. - Jour. - Helminth., 22(1), 77-92.

Stewart, F.H. 1914. Studies in Indian Helminthology No. 1, Rec. Ind. Mus., 10 165-194.

Stiles, C.W. and Hassall, H. 1920. Index- Catalogue of Medical and Veterinary Zoology ; Roundworms, U.G. Public Health Service, Hygienic Laboratory, Bull. No. 114.

Thaper, G.S. 1924. On Kiluluma, a genus of Strongyid nematodes Parasitic in the African Rhinoceros. - Jour. Helminth., 2 209-238.

Thaper, G.S. 1925. On the morphology ans systematic position of Echinopharyrx a new genus of Bursate Nematode from Testudo tabulata. - Jour. Helminth. 3, 19-32.

Thaper, G.S. 1938. Progress of Helminthology in India. - Livro Jub. Prof. Travassos, 459-465.

Thaper, G.S. 1950. Two new species of the genus Bhabdochona Railliet, 1916 from Indian Fishes. - Ind. Jour. Helminth. 2(1), 35-40.

Thwaite, J.W. 1927. On a collection of nematodes from Ceylon, 21(2), 225-244.

Verma, S.C. & Argawal, M.P. 1932. A new species of Spintectus, a new nematode from India. - Rec. Ind. Mus., 34(3), 263-268.

Yorke, W. & Maplestone, P.A. 1926. "The Nematode Parasites of Vertebrates". J.A. Churchill, London.

ANIMAL PARASITIC NEMATODES

Agarwal, M.P. 1930. "A new Nematode, Procamallanus Mehrii n.sp. from a local siluroid fish, Wallagoattu." Alld. Univ. Stud. Vol.6, Part II (Science Section) 50-64.

Ali, S.M. 1954. On a new species of the hematode genus Viguiera from the paradise flycatcher. Proc. Ind.Sc. Cong. 41st (1954) Part IV, P.32.

Ali, S.M. 1960. On some new species of the genus Oxyspirura from birds in Hyderabad, Andhra Pradesh, India. Jour. Helminth. 34 : 221-242.

Annereaux, R.F. 1946. A New Nematode, Procamallanus Pereirai, with a key to the genus. Trans. Amer. Microsc. Soc. 65(4), 299-303. (W.L. 214000).

Barus, V. 1963. Ein beitrag zur systematik des genus Oxyspirura Drasche in stossich, 1897 (Nematoda : Thelaziidae).

Baylis, H.A. 1921. A new genus of nematodes parasitic in elephants. Parasit. 13 : 57-66.

Baylis, H.A. 1923. Report on a collection of parasitic Nematodes mainly from egypt" Parasit. Vol.15, pp.26-28 C.W.L. (16035).

Baylis, H.A. 1924. A new species of Physaloptera (Nematoda) from an Australian lizard. Ibid. Ser.9, 13, 309-311.

Baylis, H.A. 1928. On a collection of nematodes from Nigerian mammals (Chiefly Rodents) - Parasit, 20(3), 280-304.

Baylis, H.A. 1929. Parasitic Nematoda and Acanthocephala collected in 1925-1927. Discovery Repts. Govt. Dependencies Falkland Ist 1, 1, 541-560.

Baylis, H.A. 1933. On a collection of Nematodes from Malayan reptiles - Ann. & Mag.Nat. Hist. (10), 11(66), 615-633.

Baylis, H.A. 1934. On a collection of cestodes and Nematodes from Small Mammals in Tanganyika Territory - Ann. & Mag. Nat. Hist. (10), 13(75), 338-353.

Baylis, H.A. 1934a. Some new apiruid nematodes from Queensland. Ann. & Mag. Nat. Hist., (10), 14(79), 142-153.

Baylis, H.A. 1935. Two new parasitic nematodes from Ceylon - Ann. & Mag. Nat. Hist., (10), 16, 187-192.

Baylis, H.A. & Daubney, R. 1922. Report on the Parasitic Nematodes in the collection of the zoological survey of India - Mem. Ind. Mus. 7(4), 263-347.

Caballero, Y.C.E. 1937. Contribution al conocimiento de los nematodos de las aves de Mexico. II. Rev. Med. Trop. Y Par. 3(1), 25-35.

Caballero, Y.C.E. 1938. Contribution al conocimiento de los nematodos de las aves de Mexico. V. (English Summary J. Livro Jub. Travassos, 91-98.

Caballero, Y.C.E. 1938. Nematodes Parasites des reptiles du Mexique. Ann. Parasitol., 16(4), 1, 327-333.

Caballero, Y.C.E. 1939. A new Filarid worm from mexican bats. Tr. Am. Micr. Soc., 58(4), 456-458.

Caballero, Y.C.E. 1939a. A new species of Camallanus from the Stomach of Kinosternon hirtipes. IV. Parasit. 31(4), 448-450.

Caballero, Y.C.E. 1939b. Nematodes de los reptiles de Mexico. III. (English Summary). An. Inst. Biol., Univ. Nac. Mexico. 10(1-2), 73-82.

Caballero, Y.C.E. 1939c. Nematodes de los reptiles de Mexico. V. (English Summary). An. Inst. Biol. Univ. Nac. Mex. 10(3-4), 275-282.

Caballero, Y.C.E. 1942. Description de Parallintostius tadaridae n.sp. (Nematoda : Trichostrongylidae) de los Murcielagos de Mexico (English Summary). An. Inst. Biol. Univ. Nac. Mexico. 13(1), 105-109.

Caballero, Y.C.E. 1942. Nematodos de las aves de Mexico. IX. Description de una nueva especie del genero Oxyspirura y consideraciones acerca de las especies Mexicanas ya conocidos (English Summary). Ibid. 13(2), 527-532.

Chakravarty, G.K. 1939. On the Nematode cemallanus anabantis pearse. Sci. & Culture, 5(5), 317-318.

Chakravarty, G.K. 1942. A new Nematode Camallanus Salmonae from Kashmir. Curr. Sci., 11(11), 441-442.

Chandler, A.C. 1942. The Helminths of racoons in East Texas - Jour. Parasit., 23(4), 255-268.

Cobbold, T.S. 1879. Parasites : a treatise on the entozoa of man and animals, including some account of the ectozoa. xi + 508 pp. London.

Cram, E. 1937. A new Nematode from the rat and its life history. Proc. U.S. Nat. Mus. Art. 15, 1-7.

Diaz-Urgria, C. 1963. Nematodes Parasitos colectados Porla Mision Chauvancy en Guayana Francesa. Bull. Mus. Nat. Hist. Nut. 35 : 441-453 (French Summary, P. 452).

Diesing, K.M. 1961. Revision der Nematodan. Sitzungsb. Akad. Wiss. Math. Naturw. Cl. 42(28), 595-736.

Drasche, R. 1884. Nematoden aus Testudo graeca. Ibid., 33, 325-330.

Dujardin, F. 1845. Histoire naturelle des Helminthes ou vers intestinaux. Paris. xvi + 654 + 15pp.

Freitas, J.F. Texeira de. 1951. Ophidascaris Sicki n.sp. (Nematoda : Ascaroidoa), Rev. Brasil. Biol., 11(3), 255-258.

Fujita, T. 1929. On new species of nematodes from fishes of Lake Biwa. Jap. J. Zool. 1(5), 169-176.

Fujita, T. 1927. Parasitic nemathelminthes found in fishes of Lae wiwa. Dobuts. Zasshi 39, 39-45; 157-161; Jap. J. Zool. 2(2), 86-87, 88.

Gedoelst, I. 1916. Notes Sur la Faune Parasitaire du congo Belge. - Rev. Zool. Africaine. 5, Fanc. 1.

Hsii, H.F. 1933. A new nematode Anisakis alata From the Walrus Pek. Nat. Hist. Bull. 8(1), 59-62.

Hsii, H.F. 1933. On Some parasitic nematodes collected in China. Parasit. 24 : 512-541.

Hsii, H.F. 1935. A study of some strongyloidea and spiruroidea from French Indo - China and of Thelazia chungkingensis Hsii, 1933, from China. Zeitschr. Parasit. 7(5), 579-600.

Hsue, H.F. & Hoeppli, R. 1931. Parasitic Nematodes mostly from snakes collected in China. - Nat. Med. Jour. China, 17(4-5), 567-588.

Jairajpuri, D.S. & Siddiqi, A.S. 1967. A review of the genus Oxyspirura Drasche in Stossich, 1897. (Nematoda : Thelaziidae) with descriptions of fourteen new species. Jour. Helminth. 12 : 337-363.

Johnston, T.H. 1912. Internal parasites recorded from Australian birds. Emu 12(2), 105-112.

Johnston, T.H. & Mawson, P.M. 1940. Nematodes from South Australian marsupials. Tr. Roy. Soc. Austr. 64(1), 95-100.

Johnston, T.H. & Mawson, P.M. 1941. Some nematode parasites of Australian birds. Proc. Linn. Soc. N. Southwales (295-296), 66(3-4), 250-256.

Johnston, T.H. & Mowson, P.M. 1941. Some parasitic nematodes in the collection of the Australian Museum. Rec. Austr. Mus. 21(2), 9-16.

Johnston, T.H. & Mowson, P.M. 1942. Gallard collection of parasitic nematodes in the Australian Museum Rec. Austral. Mus., 21(2), 110-115.

Johnston, T.H. & Mowson, P.M. 1942. Nematodes from Australian albatrosses and petrels. Tr. Roy. Soc. South Australia. 66(1), 66-70.

Johnston, T.H. & Mowson, P.M. 1947. Some nematodes from Australian lizard. Ibid. 71(1), 22-27.

Johnston, T.H. & Mowson, P.M. 1947. Some avian and fish nematodes, chiefly from Tailem Bend, South Australia. Rec. South Austral. Mus. 8(4), 547-553.

Karve, J.N. 1930. Some parasitic nematodes of Frogs and toads. Ann. Trop. Med. Par. 24(4), 481-491.

Khalil, M., and Vogelsang, E.G. 1930. Cruzia Fulleborni, a New species of Nematoda From Tupinambis 72-74, teguixin. Ctbl. Bakt. I. Orig. 119(1-2).

Khalil, M., 1932. Parasites From Liberia and French Guinea, first part : Nematoda Zeitschr. Parasitenk. 4(3), 431-458.

Khera, S. 1954. Nematode parasites of some Indian vertebrates. Ind. Jour. Helminth. 6:27-133.

Khera, S. 1956. Nematode parasites of some Indian vertebrates. Ind. J. Helm. 6(2), 17-133.

Kreis, H.A. 1938. Beitrage Zur kenntnis parasitischer Nematodon, VI. Parasitische Nematodon Aus dem Zool. Garten in Basel. Ctbl. Bakt. I. Orig. 141(5-6), 279-304.

Kreis, H.A. 1938 Idem. VII. Parasitische Nematodon dez Schweizerischen wissenschaftlichen Expedition naoh Angola (Afrika) im Jahre 1932. Ibid. 142(1-2), 90-105.

Kreis, H.A. Idem. VIII, Neue parasitische Nematoden aus dem Naturhistorischen Museum Basel. Ibid.

Kung, C.C. Some new nematodes from the Australian Wallby (Macropus rufogrisea fruticus) with a note on the synonymy of the genera Zoniolaimus, Labiostrongylus and Buccostrongylus. J. Helm. 22(2).

Leidy, J. 1851. Description of new species of entozoa. Proc. Acad. Nat. Sc. Phila, 5(7), 155-156.

Levashov, M.M. 1929. Beitrag zur kenntnis der Fauna der parasitischen Nematoden aus unterem wolgagebiete. Z. Parasit. 2(1), 121-128.

Li, H.C. 1935. The taxonomy and early development of <u>Procamallanus</u> <u>Fulvidraconis</u> n.sp. <u>J</u>. <u>Par</u>. 21(2), 103-113.

Linstow, O. Von 1898. Nemathelminthen Von Herrn Richard Semon in Australien gesammelt (Zool. Forschungsreisen in Australien und dem Malayischen Archipel. Richard Semon. Jena). Denkschr. Med. - Naturw, Gesellsch. <u>Jena</u>. 8, 469-472.

Linstow, O. Von 1898. Idem. Zool. Centra lbl, 5(20), 672.

Linstow, O. Von 1903. Parasiten, meistens Helminthen, aus Siam. Arch.Mikr. Anat., 62(1) 108-121.

Magath, T.B. 1919. <u>Cmallanus</u> <u>americanus</u>. nov. Spec., a monograph on a nematode species. <u>Tr</u>. <u>Am</u>. <u>Micr</u>. <u>Soc</u>. 38(2), 49-170.

Maplestone, P.A. 1926. Observations on the development of hookworm larvae, Pt. 1. <u>Ann</u>. <u>Trop</u>. <u>Med</u>. & <u>Par</u>. 20(1) 49-84; Pt. 2. Ibid.

Molin, R. 1860. Una monografia del genere spiroptera. <u>Ibid</u>., 38(28), 911-1005.

Molin, R. 1860, Una monografia del genera Dispharagused una monografia del genere Histiocephalus. <u>Ibid</u>. 39(3), 479-516.

Molin, R. 1860. Trenta specie di nematoidi, <u>Ibid</u>. 40, 331-358.

Molin, R. 1861. II Sottordine degli acrofalli ordinato scientificamente secondo i risultamenti delle indagini anatomiche ed embriogeniche. Mem. R. Ist. Veneto Sc. Lett. ed Arti, Venezia, 9, 427-633.

Olsen, L.S. 1954. A new species of Camallanus (Nematoda) from a fijian marine fish. Tr. Am. micr. soc., 73(3) 258-260.

Ortleep, R.J. 1925. Observations on the life history of Triodontophorus tenuicollis, a nematode parasite of the horse. Ibid, 3(1), 1-14.

Ortleep, R.J. 1925. On Arthrocephalus gambiensis, n. g., n.sp., a new ankylostome from an African mongoose. Ibid., 3(3-4), 151-156.

Ortleep, R.J. 1925. A review of the members of the genus Streptopharagus Blanc, 1912, Ibid. 3(5), 209-216.

Pearse, A.S. 1933. Parasites of Siamese Fishes and Crustaceans. J. Siam. Soc. Nat. Hist. Supplem, 9(2), 179-191.

Pearse, A.S. 1934. "Parasites of Siamese Fishes and Crustaceans." Jour. Siam. Soc. Vol. IX 171-191.

Pereira, C., and Vaz, Z. 1934. Redescripcao do Tetracheilonema quadrilabiatum Molin. Ibid. 5(1), 51.

Pereira, C. 1937. On Thelandros Scleratus Travassos, 1923. Rabot. Gelm. (Skrjabin), 463-466.

Railliet, A., and Henry, A. 1915. Sur les helminthes de l' elephant d' Asie. Note Complementaire, Bull. Soc. Path. Exot., 8(3), 117-199.

Railliet, A., and Henry, A. 1915. Sur les nematodes du genere Goezia Zeder. Bull. Soc. Path. Exot., 8(5), 270-275.

Railliet, A., and Henry. A. 1915. Sur les nematodes du genera Camallanus Raill, and Henry, 1915 (Cucullanus auct., non mueller, 1777) Ibid. 8(7), 446-452.

Railliet, A., and Henry, A. 1915. Le parasite de la dermite granuleuse des equides, Ibid., 8(9), 695-704.

Ransom, B.H. 1904. Manson's eye worm of chickens (Oxyspirura mansoni), with a general review of nematodes parasitic in eyes of birds. U.S. Dept. Agri. Bureau Animal Indust. Bull. No.60, 1-54.

Rao, M.A.N. 1939. Gyalocephalus capitatus Looss, 1900. Ibid., 9(2), 179-180.

Rao, M.A.N. 1939. Gyalocephalus gambiensis Ortleep, 1925. Ibid., 9(1), 37-38.

Rasheed, S. 1960. The nematode parasites of the birds of Hyderabad (India). Biologia, Lahore 6:116.

Ribeiro, D.J. 1941. Pesquisas helminthologicas realizadas no Estado do Para VIII. Camallanus amazonicus n.sp. Parasito de Podocnemis expansas (Schw). Mem. Inst. Oswaldo Curz (1940), 35(4), 723-728.

Robinson, V.C. 1934. On a collection of parasitic worms from Malay. I. Nematodes (Superfamilies Ascaroidea and Oxyuroidea). Parasit. 25(4), 481-488.

Sandground, J.H. 1929. A new Liver Fluke from a monkey a and new parasitic roundworms from various African animals. Pr. U.S. Nat. Mus. 75(12), 1-11.

Schneider, A.F. 1866. Monographie der Nematoden, Berlim. XIII + 357, pp.

Schuurmans Stekhoven. J.H. 1937. Parasitic Nematoda. Fasc. (4), Mission (de witte) 1933-35). Explor. Parc. Nat. Albert, 40pp.

Schuurmans Stekhoven. J.H. 1950. Nematodos parasitarios del chaco paraguayo Y de Argentina del museo de Estocolmo. Acta. Zool. Lilloana 9, 325-345.

Schwartz, B. 1925. Parasitic nematodes from Tonkin, Indo-China, including a new species of Ascaridia. Proc. U.S. Nat. Mus., Vol. 66, art.1, 1-9.

Schwartz, B. 1925. Two new larval nematodes belonging to the genus Porrocaecum from mammals of the order Insectivora:Ibid., 67(7), 1-8.

Siddiqi, A.H. and Jairajpuri, M.S. 1964. Remark of the genus Oxyspirura (Nematoda : Thelaziidae) with description of Oxyspirura (O) basiri n.sp. Proc. Helminth. Soc. Wash. 31:89-92.

Singh, S.N. 1948. Studies on the helminth parasites of birds in Hyderabad State.Nematoda I Jour. Helminth. 22:77-92.

Singh, S.N. 1948. Studies on the helminth parasites of birds in Hyderabad State. Nematode. II. Jour. Helminth. 22:199-218.

Skrjabin, K.I. Neue Nematoden der Gattung Oxyspirura Drasche aus dem Vogelauge. Z. Parasit. 3(4), 726-740; Ann. Par. 10(1), 103.

Skajabin, K.I. Schikhobalova, N.P. and Sobolev, A.A. 1949. Spirurata and Filariata. 519pp.

Southwell, T. and Kirshner, A. 1937. On some parasitic worms found in xenopus laevis, the South African clawed toad. Ann. Trop. Med. Par. 31(2), 245-265.

Sprehn C.E.W. 1929. Eine neue Ascaride. Ophidascaris arndti n.sp. aus einer Siidamerikanischen Schlange Zool. Anz. 83(11-12), 280-283.

Stossich, M. 1897. Filarie e Spiroptere. Ibid. 18, 13-162.

Stossich, M. 1899. Strongylidae. Ibid. 19, 55-152.

Sultana, A. 1964. Some new eye worms from birds in India, Zeit.Fur.Parasit. 23 : 532-547.

Strachan, A.A. 1957. Eye worms of the family Thelaziidae from Brazilian birds. Canad. J. Zool. 35, 179-187.

Sweet, G. 1910. Some new and Unrecorded endoparasites from Australian chickens. Proc. Roy. Soc. Victoria, n.s., 23(1), 242-256.

Tornquist, N. 1931. Die Nematoden Familien Cucullanidae Und Camallanidae Goteb. Kungl. Vet. - Och Vett. Samh. Handl. Ser. B., 2(3), 441pp.

Vaz, Z. 1935. Lesoes produzidas no estomago de Cobras porum novo nematoide Ophidascaris trichuriformis n.sp. Arch. Inst. Biol. 6, 41-44.

Vaz, Z. 1935. Redescricao de Arthrocephalus maxillaris (Molin 1860) necatorineo parasita de Procyon, Cancrivorus, Rev. Biol. e Hyg, 6(1), 9-12.

Vaz, Z. 1935. Sobre a pretensa validez de syngamus nasicola-presenca do synganus laryngeus nas fossas nasaes de Carneiros do Brasil. Arch. Inst. Biol. S. Paulo, 6, 35-39.

Vaz, Z. 1938. Nova especie do genero Ophidascaris parasita da Cascavel (Crotalus terrificus) Livro Jub. Travasos, 495-500.

Vuylsteke, C. 1953. Notes sur les nematodes parasites de l' elephant d' Afrique. Ibid. 48(3-4), 213-239.

Vuylsteke, C. 1953. Nematodes, parasites d' oiseaux. Mision (de witte) (1946-49). Eplor. Parc Nat. Upemba, Fasc. 17, 1-41.

Walton, A.C. 1927. A revision of the nematodes of the Leidy collections. Proc. Acad. Nat. Sc. Phila, 79, 49-163.

Walton, A.C. 1932. Amphibian parasites of the orders Strongyloidea, Dioctophymoidea and Trichinelloidea (Nematoda), J. Par. 19(2), 164.

Walton, A.C. 1935. The Nematoda as parasites of Amphibia. II. J. Par. 21(1), 27-50. Correction. Ibid., 315.

Walton. A.C. 1937. The Nematoda as parasites of Amphibia.III. Studies on life histories, J. Par. 23(3), 299-300.

Webster, G.A. 1956. Placoconus : a new genus for Arthrocephalus lotoris (Schwartz, 1925) Chandler, 1942. Canad. J. Zool. 34(2), 99-103.

Wehr, E.E. and Hwang, J.C. 1957. Oxyspirura Yorkespirura) pusillaen. sp. (Nematoda : Thelaziidae) from the orbital cavity of the brown-headed nuthatch, sitta pusilla pusilla Latham, 1970. J. Par. 43(4), 436-439.

Wehr, E.E. and Hwang, J.C. 1957. Systematic position of Filaria helicina Molin , 1858, from the brain cavity of the snakebird, Anthinga anhinga, J. Parasit. 43(6), 640-655.

Yamaguti, S. 1935. Studies on the helminth Fauna of Japan. Part 9. Nematodes of Fishes I - Jap. Jour. Zool. 6(2). 337-386.

Yamaguti, S. 1941. Studies on the Helminth Fauna of Japan Part 33. Nematodes of Fishes II - Jap. Jour. Zool., 9(3), 343-396.

Yeh, L.S. 1957. On Physaloptera lumsdeni n.sp. from a bush-body in Tanganyika, with a note on Abbreviata Caucasica. J. Helm. 31(1-2), 29-32.

Yeh, L.S. 1957. On Chandlerella braziliensis n.sp. from a green-billed Toucan and a discussion on some related genera. J. Helm. 31(1-2), 33-38.

Yeh, L.S. 1957. On a Filarial Parasite, Deraiorophonema Freitaslenti n.sp., from the giant anteater, Myrmecophaga tridactyla from British Guiana, and a Proposed reclassification of Dipetalonema and related fenera. Parasit 47(1-2), 196-205.

PLANT PARASITIC NEMATODES

Allen, M.W. 1955. A review of the nematode genus Tylenchorhynchus. Univ. Calif. Publis. Zoology. 61(3) : 129-166.

Allen, M.W. and Jensen, H.T. 1951. Pratylenchus Vulnus New Species (Nematoda : Patylenchinae), a Parasite of trees and vines in California, Proc. Helminth. Soc. Wash., 18 : 47-50.

Anderson, R.V. 1978. A Supplemental Key to species of Helicotylenchus Steiner, 1945. (Nematoda : Haplolaimidae) described since 1972 and a description of H. Osccphalus n.sp. Can. J. Zool. 57: 337-342.

Andrassy, I. 1954 a. Deri neue Arten aus der Superfamilie Tylenchoidea. Nematologische Nortizen. 3. Ann. Biol. Univ. Hung., 2:9-15.

Andrassy I. 1954b Revision oer qattung Tylenchus Bastian. 1865 Acta. Zool. Acad. Sci. Hung. 1: 5-52.

Andrassy, I. 1958 Hoplolaimus Tylenchiformis Doday, 1905 (Syn. H. Coronatw cobb, 1923) und die Gattungen der unter families Hoplolaiminae Filipjev, 1936. Nematologica, 3:44-56.

Andrassy, I., 1959. Taxonomische upersicht der Dorylaimen (Nematoda), I. Acta Zool. Acad. Sci. Hungaricae 5(3/4) : 191-240.

Andrassy, I. 1973 100 nave Nematodenarten in ungarischen fauna, Opusc. Zool. Bpest 11, 7-48.

Andrassy, I., 1976. Evolution as a basis for the systematization of Nematodes. Pitman Publishing, London, 288 pp.

Andrassy, I., 1979. The genera & species of the family Tylenchidaeorley, 1880 (Nematoda : Acta. Zoologica, Academiac Scientiarum Hungaricae 25: 1-2.

Ark, P.A. and H.E. Thomas, 1936. Anguillulina pratensis in relation to root injury of apple and other fruit trees. Phytopathology 26(12) : 1128-1134.

Bagri, Q.H. & Jairajpuri, M.S., 1969. Two known & three new species of Nematodes associated with fibrous crops in India. Annls. Zool. Ecol. Anim., 1, 327-337.

Bagri, Q.H. and Jairajpuri, M.S 1970. On the intraspecific variations of Tylenchorhynchus Mashoodi Siddiqi & Basir, 1959 and an emended key to the species of Tylenchorhynchus Cobb, 1913 (Nematoda). Revta Bras. Biol. 30:61-68.

Bajaj, H.K. and Jairajpuri, M.S. 1977a. Statistical analysis of variability in a population of Xiphinema Basiri Siddiqi, 1959 Nematol. Meoit : 5(2) : 269-280.

Bajaj, H.K. and Jairajpuri, M.S. 1977b. Studies on nematode behaviour. X. Observations on Feeding of Xiphinema basiri tomato. Indian J. Nematol., 7(1) : 91-93.

Bajaj, H.K. and Jairajpuri, M.S. 1979. A Review of the genus _Xiphinema_ Cobb, 1913 with descriptions of species from India, _Rec_. _Zool_. _Surv_. _India_ ; 75: 255-325.

Bajaj, H.K. and Bhatt, D.S., 1983. Aphelenchid Nematodes From Haryana. _Indian_ _J_. _Nematol_. (1982). _12_(2): 258-263.

Baker, A.D., 1962, _Check lists of the Nematode superfamilies_ _Dorflaimoides_, _Rhabditoidea_ _Tylenchoidea_ and _Aphelenchoidea_. Leiden, E.J. Brill. : 261 pp.

Banergi, S.N. and Banergi, D.K., 1966. Occurrance of the Nematode _Hoplolaimus_ _indicus_ in W. bengal. _Cull_. _Sci_. _35_(23) : 597-598.

Bastian, C.H. (1865) : Monograph on Anguillulidae or Free Nematodes, Marine land and Fressh Water, with description of 100 new species. _Trans_. _Linn_. _Soc_. _London_ 25:73-184.

Baylis, H.A. and R. Daubney. 1926. A synopsis of the families and genera of Nematoda, London.

Birchfield, W. and Martin. W.J. 1956. Pathogenecity on sugarcane and host plant studies of a species of _Tylenchorhynchus_. _Phytopathology_. _46_: 277-280.

Bridge, J., 1974. Hatching of _Tylenchorhynchus_ _Maximus_ and _Merlinius_ _icarus_. _J_. Nematol., _6_(2) : 101-102.

Brzeski, M.W. 1968. Plant Parasitic Nematodes associated with cabbage in Poland. I. Systematic studies. Annls. Zool. Warsz 26:249-279.

Cadman, C.H. 1963. Biology of Soil borne Viruses. In Annu. Rev. Phytopath. Vol. I. Eds. Horsfall, J.G. and Baker. K.F., Annual reviews Inc., Palo Alto, Calif.

Caveness, F.F., Gilmer, R.M. and Williams, R.J. 1975. Transmission of Cowpea Mosaic by *Xiphinema basiri* in Western Nigeria. In Nematode Vectors of Plant Virus. Eds. Lamberti, F., Taylor, C.E. and Seinhorst, J.W. London, U.K. and New York, USA. Plenum Press, 289-290 pp.

Chaturvedi, Y. and Khera, S. 1979. Studies on taxonomy, Biology and Ecology of nematodes associated with Jute crop. Zool. Surv. India. Tech. Monogr., No.2, V + 105 pp.

Chawla, M.L. and Yadav, S.M. 1981a. Effect of Pot Culturing on morphometric characters of *Hoplolaimus indicus*. Indian J. Nematol. (1980). 10(2) : 246-247.

Chawla, M.L. and Yadav, S.M. 1981b. Studies on the extent of variation in *Hoplolaimus indicus* Sher, 1963. I. Morphological characters. (Abstr.) Indian J. Nematol., 11(1) : 117-119.

Christie, J.R. 1939. Predaceous nematodes of the genus Aphelenchoides from Hawaii. Jour. Acad. Sci. 29(4) : 161-171.

Cobb, N.A. 1913. New nematode genera found inhabiting fresh water and honbrackish soils. J. Wash. Acad. Sci., 3:432-444.

Cobb, N.A., 1917. A New Parasitic nema found infesting Cotton and Potatoes. Jour. Agr. Res. 11(1) : 27-33.

Cobb, N.A., 1919. A new nema. Tylenchus Musicola, n.sp. said to cause a serious affection on the Bluggoe banana in Grenada, British West Indies. W. I. Bull. 17:179-182.

Cobb, N.A., 1923. An emendation of Hoplolaimus Daday, 1905, Nec ductores J. Wash Acad. Sci., 13: 211-214.

Cobb, N.A., 1927. Notes in Proc. Helminth Soc. Wash: Jour Parasit. 14:54-72.

Cohn, E. and Sher, S.A., 1972. A Contribution to the taxonomy of Xiphinema. J. Nematol. 4:36-65.

Daday, J., 1905. Untersuchungen Uber die Susswasser Mircro found Paraguays. Zool. Stutgart, 18: 1-349.

Dalmasso, A., 1960. Etude Anatomique et taxonomique des genera Xiphinema, Longidorus et Paralongidorus (Nematoda : Dorylaimidae) Mem. Mus. natn. Hist. nat. ser. A. Zool. 61:33-82.

Das, V.M. 1960. Studies on the nematode parasites of plants in Hyderabad (Andhra Pradesh, India) Z. Parasitenk. 9:553-605.

Dasgupta, D.R., Nana, S. and Seshaorl, A.R. 1970. Culturing, Embryology and life History studies on the lance nematode, Hoplolaimus indicus. Nematologica, 16:235-248.

Das, P.K. and Rao, Y.S. 1970. Life history and Pathogenesis of Hoplolaimus indicus incidence in rice. Indian Phytopath., 23(3) : 459-464.

Das, V.M. and Shivaswany, v. 1977. Hoplolaimus Singhi n.sp. and Hemicycliophora Osmani n.sp. from Andhra Pradesh, India. Riv. Parassit. (1916), 37(213):259-264.

Das, V.M. and Sultana, S. 1979. Five new species of the genus Pratylenchus from Vegetable crops of Hyderabad (Andhra Pradesh). Indian J. Nematol., 9(1) : 5-14.

Darekar, K.S. and khan, E. 1982. Xiphinema tugewai sp. n. and Longidorus Paramirus sp.n. (Longidoroidea : Nematoda) From Maharashtra, India. Indian J. Nematol., 12(1) : 153-157.

Deker, H. 1972. Zur Systematik der Phytonematoden der ordnung Tylenchida Thorne, 1949. In: Probl. Phytonematol. Gross Lusewitz : 51-75.

Edward, J.C. and Misra, S.L. 1969. Occurrence of some new species of Aphelenchoidea in the rhizosphere of certain field crops of Uttar Pradesh, India. Nematologica, 9: 405-411.

Fotedar, D.N. and Kaul. V., 1965b. A revised key to the species of genus Helicotylenchus Steinen 1945 (Nematod : Rotylenchus) Indian. J. Nematol. 15(2) : 138-147.

Fotedar, D.N. and Mahajan, R. 1971. On a New Species of the genus Tylenchorhynchus Cobb, 1913 (Nematoda : Tylenchorhynchidae) From Kashmir, India. Kashmir Science, 8(1/2) : 120-122.

Filipjev, I.N., 1934. The classification of the free living Nematodes and their relation to the Parasitic Nematodes. Smithsonian Misc. Coll. (3216) 86(6) : 1-63.

Filipjev, I.N., 1936a. On the classification of Tylenchinae. Proc. Helminth Soc. Wash. 3 : 80-82.

Filipjev, I.N. and Schuurmans Stekhoven, J.H., 1941. A. manual of Agricultural helminthology. Brill, Leiden, 878pp.

Fischer, J.M., 1894. Ubereine Clematiskrankheit - Ber. Physiol. Lab. Univ. Halle. 3 : 1-11.

Fuchs, A.G., 1931. Seinura gen. Nov. Zool. Anz. 94:226-228.

Goodfrey, G.H. 1929. A destructive root disease of bineapple and other plants due to *Tylenchus brachyurus* n.sp. Phytopathology 19(7) : 611-629.

Goffart, H. 1929. Beobachtungen iiber *Anguillulina Pratensis* deman. Zeitschr. Parasitenk. 2(1) : 79-120.

Golden, A.M., 1956. Taxonomy of the spiral nematodes *Rotylenchus* and *Helicotylenchus*), and the developmental stages and host parasitic relationships of *R. buxophillus*. n.sp. attacking boxwood. *Bull. Md. agric. exp. stn.*, A-85, 1-28.

Golden, A.M., 1971. Classification of the genera and higher categories of the order Tylenchida (Nematoda). In *Plant Parasitic Nematodes. Ed. Zuckerman, B.M. & Mai, W.F. New York & London* : *Academic Press*, 191-232 pp.

Goodey, T. 1932. On the nomenclature of root-gall nematodes. Jour. Helminth, 8(4): 197-210.

Goodey, T. 1933. *Plant Parasitic Nematodes and the diseases they cause*. Methuen & Co.; London, 306 pp.

Goodey, T., 1951. *Soil and Fresh Water nematodes*. London, Methuen; 390 pp.

Goodey, J.B. 1957. Laboratory Mehods for work with plant and soil nematodes. *Tech. Bull. Minist. Agric.* London, No. 2 (3rd edition) London H.M. 500.

Goodey, J.B., 1960. The classification of the Aphelenchoidea Fuchs, 1937. Nematologica, 5(2): 111-126.

Goodey, J.B., 1962. Tylenchus (Cephalenchus) Megacephalus n. subg. n.sp. Nematologica, 7 : 331-333.

Goodey, J.B., 1960. The classification of the Aphelenchoidea Fuchs, 1937. Nematologica. 5(2) : 111-126.

Graham, T.W. 1954. The tobacco stunt nematode in South Carolina (Abstr.) Phytopathology, 44 : 332.

de Guiran, G. 1967. Description de deux especes nouvelles du genera Tylenchorhynchus Cobb, 1913 (Nematoda : Tylenchinae) accompagnee d' Une cle de Femelles, et Precision sur T. Mamillatus, Tobar Jimenez 1966. Nematologica, 13:217-230.

Gupta, N.K. and Gupta, J.C. 1967. On a nematode species of the genus Hoplolaimus Daday, 1905 from a Citrus Plant in the Punjab. Res. Bull. Pb. Univ. Sci. (1966), 17(314) : 211-213.

Gupta, N.K. and Uma., 1980a. Tylenchorhynchus Penniseti n.sp. (Nematoda : Tylenchorhynchidae). Indian J. Parasit., 4(2) : 157-159.

Gupta, N.K. and Uma., 1980b. On a new species of genus Tylenchorhynchus Cobb., 1913 (Family : Tylenchorhynchidae) (Eliava, 1964) Golden, 1971). Revta iber. Parasit., 40(4) : 423-427.

Gupta, N.K. and Uma., 1981a. Description of two new species of the genus Tylenchorhynchus Cobb, 1913 (Family Tylenchorhynchidae) (Eliava, 1964) Golden, 1971. From India. Helminthologia, 18(1) : 53-59.

Gupta, N.K. and Uma., 1981b. A new nematode species of the genus Tylenchorhynchus Cobb, 1913 from Goa, India, Indian J. Parasit., 5(1):37-38.

Gupta, N.K. and Uma., 1981c. Tylenchorhynchus Oleraceae n.sp. (Family : Tylenchorhynchidae) (Eliava, 1964 Golden, 1971). From around roots of Cauliflower.

Harrison, B.D. 1960. The biology of soil borne plant viruses In Advances in Virus research Vol. 7, Eds, Smith K.M. and Lauffer, M.A., New York, Academic Press, 146-148, 155pp.

Harrison, B.D., 1964. The Transmission of plant viruses in the soil. In plant virology. Eds. Corbett, M.K. and Sister, H. P. Univ. of Flo., Press Gainesville, 118-147 pp.

Hechler, H.C. and Taylor, D.P., 1965. Taxonomy of the genus Seinura (Nematoda : Aphelenchoididae), with the description of S. Celebris n.sp. and S. Steineri n.sp. Proc. helminth. Soc. Wash; 29 : 162-167.

Hewitt, W.B., Raski, D.T. and Goheen, A.C., 1958. Nematode vector of soil-borne fanleaf virus of grapevines. Phytopathology, 48 : 586-595.

Hofmanner, B., and R. Menzel. 1914. Neue Arten Freilehender. Nematoden aus der schweiz. Zool. Anz. 44:80-91.

Hooper, B.E., 1959. Three new species of the genus Tylenchorhynchus (Nematoda : Tylenchidae) Nematologica 4, 23-30.

Husain, S.I. and Khan, A.M., 1965. "Seinura nagini n.sp. (Nematoda : Aphelenchoididae) form North India". Proc. helminth. Soc. Wash. 32(2) : 179-181.

Husain, Z. and Rashid, A. 1969. Studies on morhological variations in Hoplolaimus indicus Sher, 1963. (Abstr.). All India Nematol. Symp. New Delhi, August 21-22, 1969. 27 p.

Jairajpuri, M.S. 1966. A redefinition of Psilenchus de Man, 1921 and Tylenchus Subgenus Filenchus Andrassy, 1954 with the erection of clavilenchus n.subgenus and Tylenchus Bastian, 1865. Nematologica (1965). 11: 619-622.

Jairajpuri, M.S. and Bagri Q.H. 1973. Nematodes of High Altitude in India I. Four New Species of Tylenchida. Nematologica, 19:19-30.

Jairajpuri, M.S. and Lamberti, F. 198. Xiphinema Bajaji nom. nov. For Xiphinema Luci Bajaj and Jairajpuri, 1979 (Nematoda : Longidoridae). Nematol. Medit. 8(2):211.

Jensen, H.J., 1950. The Biology and Morphology of the root-lesion nematode parasitic on wodnuts in California. (Unpublished Ph.D. dissertation) University of California Library.

Jones, R.K. 1978. The feeding behaviour of Helicotylenchus Spp. On Wheat Roots. Nematologica, 24:88-94.

Kannan, S. 1961. Soil Nematodes of Madras City II. J. Zool. Soc. India, 13(1) : 56-61.

Khan, E., 1965. Longidorus afzali n.sp. and Xiphinema arcum n.sp. from India. Nematologica, 10: 313-318.

Khan, E. 1981. Inagreius gloriosus gen. n., sp., n. and descriptions of three new species of Xiphinema Cobb, 1913 along with reported on X. radicicola T. Goodey, 1936 and X. elongatum Sch. Stek and Teun, 1938 (Nematoda : Longidoroidea) From India. Indian J. Nematol. 11(2) : 189-284.

Khan, S.H. and Ahmad, S. 1975. Longidoroidea (Thorne, 1935) n. rank. (Nematoda : Dorylaimina) with the description of Xiphinema Neoamericanum n.sp. from India and proposal of a new name for X. americanum Sensu Carvalho (1956) non Cobb. 1913. Nematol. Medit., 3:23-2b.

Khan, E. and Chawla, M.L. 1975. Hoplolaimus indicus. C.I.H. Descriptions of Plant Parasitic Nematodes, Set 5, No.66, 4pp.

Khan, E. and Darekar, K.S., 1979. Indian J. Nematol. (1978), 8(1) : 43-48.

Khan, E. and Nanjappa, C.K., 1972 a. Four new species in the Superfamily Hoplolaimoidea (Tylenchida : Nematoda) from India. Bull. Ent. (1970), 11(Z) : 143-149.

Khan, E. and Nanjappa, C.K., 1972b. Pseudhalenchus acutus Sp. n. and Tylenchorhynchus aerolatus, sp.n. (Nematoda : Tylenchida) from India. Bull. Ent. (1971), 12:55-58.

Khan, E. and Singh, D.B., 1975. Five new species of Pratylenchus (Nematoda : Pratylenchidae) from India. Indian J. Nematol (#974), 4(2) : 199-211.

Klinkenberg, C.H. 1963. Observations on the feeding habits of Rotylenchus Uniformis Pratylenchus Crenatus, P. Penetrans, Tylenchorhynchus dubius and Hemicycliophora Similis, Nematologica, 9: 502-506.

Knobloch, N.A. and Laughlin, C.W. 1973. A Collection of plant parasitic Nematodes (Nematoda) from Mexico with descriptions of three new species. Nematologica, 19:205-217.

Krusberg, L.R. 1959. Investigations on the life cycle, reproductio, feeding habits and host range of _Tylenchorhynchus Claytoni_. _Nematologica_, _4_(3): 187-197.

Kumar, P. 1981. On new species of _Tylenchorhynchus_ and _Helicotylenchus_ from Cauliflower (_Brassica Oleracea_ Var. _botrytis)_ at Lucknow. _Kanpur Univ. Res. J_. (1980). 1(Dec.) : 185-192.

Lenman, P.S. 1981. _Hoplolaimus Indicus_ a ectoparasitic nematode: Pathogenic to Citrus in India. _Nematology Circular_, _Div. el. Industry_, _Florida Dept. Agric. Consumer Services_, No. 76:2pp.

Linford, M.B. and Oliveira, J.M. 1937. The Feeding of hollowspear Nematodes. _Proc. helminth. Soc. Wash._, (_4_) (2):41-46.

Loof, P.A.A. 1964. Taxonomic studies on the genus _Pratylenchus_ (Nematoda) _Tijdschr. Pl. Ziekt._, _66_:29-90.

Loof, P.A.A. 1978. The genus _Pratylenchus_ Filipjev, 1936 (Nematoda : Pratylenchicae) : a review of its anatomy, morphology, distribution, systematics and identification. _Uppsala, Sweden : Swedish University of Agricultural Sciences, Research Information Centre_. iv + 50 pp. ISBN 91-7088-980-5.

Loof, P.A.A. and Mass, P.W.Th. 1972. The genus Xiphinema (Dorylaimida) in Surinam. Nematologica, 18: 92-119.

Loof, P.A.A. and M. Oostenbrink. 1958. Die Identitat Von Tylenchus robustus deMan. Nematologica 3(1): 34-43.

Loof, P.A.A. and Yassin, A.M. 1970. Three new plant parasitic nematodes from Sudan, with notes on Xiphinema basiri Siddiqi, 1959. Nematologica, 16:537-546.

Luc, M., 1958a. Xiphinema de l' Ouest Africain description de Cing Nouvelles especes (Nematoda : Dorylaimidae) Nematologica 3(1) : 57-72.

Luc, M., 1981. Basirolaimus Shamsi, 1979, a Junior synonym of Hoplolaimus Von Daday (Nematoda : Tylenchida) Nematal. Medit, 9(2) :197-199.

Luc, M. and Dalmasso, A., 1975. Considerations on the genus Xiphinema Cobb, 1913 (Nematoda : Longidoridae) and a "lattice" for the identification of species. Cas. ORSTOM. Ser. Biol. 10:303-327.

Luc, M. and Tarjan, A.C. 1963. Note Systematique Sur le genera Xiphinema Cobb, 1913 (Nematoda : Dory laimidae). Nematologica, 9:111-115.

Mahajan, R. 1973. Two new nematodes, _Tylenchus Kashmirensis_ n.sp. (Tylenchidae) and _Dorylaimoides Pari_ n.sp. (Dorylaimoididae) from Kashmir, India. _Riv. Parassit._, _34_:201-204.

Mahajan, R. 1974. _Tylenchorhynchus Kashmirensis_ sp.n. and _Quinisulcius himalyae_ sp.n. (Nematoda : Tylenchorhynchinae) from India. _Proc. helminth. Soc. Wash._ _41_(1):13-16.

de Man, J.C., 1880. Die einheimi-Schen, frei in der reinin Erde Und in Sussen wasser lebenden Nematoden. _Tijdschr. ned. dierk. ver._, _5_:1-104.

Maharaju, D. and Das, V.M. 1981. _Pratylenchus nizamabadensis_ n.sp. (Nematoda : Tylenchida) from Andhra Pradesh. _Proc. Indian Acad. Parasit._ _2_(1):24-25.

Massey, C.L. 1966. The nematode parasites and associates of _Dendroctonus adjunctus_ (Coleoptera : Scolytidae) in new Mexicao. _An. ent. Soc. Am._, _59_(3):424-440.

Massey, C.L. 1971. Nematode associates of several species of _Pissodes_ (Coleoptera : Curculionidae) in the United States. _Ann. Ent. Soc. Amn._64(1): 162-169.

Mathur, U.K., Sanwal, K.C. and lal, A. 1979. _Tylenchorhynchus neoclavicaudatus_ n.sp. in Soil washings from imported Potato tubers. _Indian J. nematol._, _8_(2):148-150.

Mcleod, R.W. and Khair, G.T. 1971. Xiphinema australiae n.sp. its host range, observations on X. monohysterum Brown, 1968.

Menzed, R., 1917. Zur Kenntnis der Freilebenden Nematoden gatunig Hoplolaimus Daday. Rev. Susie Zool., 25:155-162.

Meyl, A.H. 1961. Die Freilebenden Erdund Susswassernematoden (Fadenwurmer). In Die. Tierwelt Mitteleuropas. 1(5a), Ouelle & Meyer, Leipzig, 164pp.

Mulk, M.M. and Jairajpuri, M.S., 1974. Proposed of a new genus Dalichorhynchus and a new species Dolichorhynchus nigericus (Nematoda : Dolichodoridae). Indian. J. Zool. 2(1) :15-18.

Mulk, M.M. and Jairajpuri, M.S., 1976. Nematodes of leguminous crops in India. III. Three new species of Hoplolaimus Daday, 1905 (Hoplolaimidae). Indian J. Nematol., (1975). 5(1) : 1-8.

Nand Kumar, C. and Khera, S., 1970. A new nematode species Pratylenchus Mulchandi from millets of Rajasthan. Indian Phytopath, (1969) 22:359-363.

Oostenbrink, M. 1966. Major characteristics of the relation between nematodes and plants. Meded. LanabHoogesch wageningen. 66:1-46.

Orbin, D.P. 1973. Histopathology of Soyabean roots infected with Helicotylenchus dihystera. J. Nematol., 5:37-40.

Paramonov, A.A. 1972. Plant Parasitic nematodes. Vol. III. Systematics of nematodes. superfamily Tylenchoidea. Ed. Skryabin, K.I., Jeruasalem : Israel Program for Scientific Translations, iv + 200 pp.

Perry, V.G., Darling H.M., < Thorne, G., 1959. Anatomy taxonomy & control of certain spiral nematodes attacking blue grass in Wisconsin. Bull. Wis. agric. Exp. Sta. 207:1-24.

Pitcher, R.S. 1961. Nematodes vectors of plant viruses. 6th Inter. Nematol. Symp., Gent; Belgium. 53p.

Pitcher, R.S. 1965. Inter-relationship of nematodes and other pathogens of plants. Helm. Abster., 34: 1-17.

Rao, V.S. 1970. Study of plant parasitic nematodes affecting rice production in the vicinity of cuttack (Orissa) India. (U.S.P.L. 480 Project). Final Technical Report (May the 6th, 1965 to May the 5th, 1970). Cuttack : Indian Council of Agricultural Research, 115pp.

Rashid, A, 1974. A new species of the genus Pratylenchus Filipjev, 1934 (Nematoda : ratylenchinae) from India. (Abstr.). Proc. 61st Indian Sci. Congr. Nagpur, Part III, 65.

Raski, D.J. and Hewitt, W.B., 1963. Symposium on inter relationships between nematodes and other agents causing plant diseases. Plant parasitic nematodes as vectors of plant viruses. *Phytopathology*, 53:166-170.

Roy, T.K. 1974. Notes on the pathogenicity of *Xiphinema basari* and its host records. *Indian J. Nematol*. *3*: 161-162.

Roy, T.K. 1980. A redescription of the Male of *Xiphinema basiri* Siddiqi, 1959 (Nematoda : Dorylaimoidea). Indian *J*. *Parasit*., *4*(1):47-49.

Roy, T.K. and Gupta, A.N. 1974. Comments on the taxonomic position of some species of the genus *Xiphinema* Cobb, 1913 (Nematoda : Dorylaimoidea) with the creation of a new subgenus. *Acta morph*. *neerlando Scandinavica*. *12*: 345-354.

Rensch, B., 1924. *Aphelenchus neglectus* n.sp., eine neve parasitare Nematodonart, *Zool*. *Anz*. *59*:277-280.

Roman, J., (1965) Nematodes of Pureto Rico, the genus *Helicotylenchus* Steiner 1945 (Nematoda : Hoplolaiminae) *Tech*. *Paper*, *Univ*. *Pureto*, *Rico Rio Piedras* No. 41, 23pp.

Ruchle, J.L., 1975. Response of short leafpine to Parasitism by plant parasitic nematodes. *Pl*. *Dis Reptr*. *59*:290-292.

Saxena, P.K. Chhabra, H.K. and Joshi, R., 1973. *Xiphinema neomericanum* sp. n. (Nematoda :

Longidoridae) from India. Zool. Ang. 191: 130-132.

Schuurmans-Stekhoven, J.H. and Teunissen, R.J.H. 1938. Nematodes libres terrestres. Explor. Parc. Natn. Albert 22:229 pp.

Seshadri, A.R., Muthukrishna, T.S. and Shummugam, S. 1967. A new species of Tylenchorhynchus (Tylenchidae : Nematoda) from Madras State, India. Curr. Sci., 36(20):551:553.

Sethi, C.L. and Swarup, G. 1968. Plant parasitic nematodes of North-Western India. I. The genus Tylenchorhynchus. Nematologica, 14(1) : 77-88.

Sharma, R.D. 1971. Studies on the plant parasitic nematode Tylenchorhynchus dubius. Meded. Landbhoogesch. Wageningen. 71(1):1-154.

Sharma, R.K. and Saxena, V., 1981. Two new species of the genus Xiphinema Cobb, 1913 (Dorylaimida. Nematoda) Indian J. Parasitol. 5(1):95-99.

Shamsi, M.A., 1979. Basirolaimus Geon (Nematoda : Hoplolaimidae) with the description of Basirolaimus Sacchari n.sp. From India Namtol. medit, 7(1):15-19.

Sher, S.A., 1961. A revision of the Hoplolaiminae (Nematoda). I. Classification of the nominal genera and nominal species. *Nematologica* *6*(2) : 155-169.

Sher, S.A., 1963a. Revision of the Hoplolaiminae (Nematoda) II. *Hoplolaimus* Daday, 1905 and *Aerolaimus* n.gen. *Nematologica*, *9*:267-295.

Sher, S.A., 1966. Revision of Hoplolaiminae (Nematoda) VL. *Helicotylenchus* Steiner, 1945, *Nematologica* *12*:1-56.

Sher, S.A. and Allen, M.W. 1953. Revision of the genus *Pratylenchus* (Nematoda : Tylenchidae) *Univ*. *Calif*. *Publs*. *Zool*., *57*:441-470.

Siddiqi, M.R., 1959. Studies on *Xiphinema* Spp. (Nematoda : Dorylaimoidea) from Aligarh (North India), with comments on the genus *Longidorus* Micoletzky, 1922. *Proc*. *helminth*. *Soc*. *Wash*. *26*: 151-163.

Siddiqi, M.R. 1961. Studies on *Tylenchorhynchus* SPP. (Nematoda : Tylenchida) from India. *Z*. *Parasitenk* *21*(1) : 46-64.

Siddiqi, M.R. 1963a. Four new species of the genus *Tylenchus* Bastian, 1865 (Nematoda) from North India. *Z*. *Parasitenk*., 23: 170-180.

Siddiqi, M.R. 1963b. Two new species of the genus Helicotylenchus Steiner, 1945 (Nematoda : Hoplolaiminae). Z. Parasitenk., 23(3):239:244.

Siddiqi, M.R. 1963c. Four new species in the sub-family Tyelnchinae (Nematoda) from North India. Z. Parasitenk., 23(4):397-404.

Siddiqi, M.R. 1970. On the plant parasitic nematode genera Merlinius gen.n. and Tylenchorhynchus Cobb and the classification of the families Dolichodoridae and Belonolaimidae n.rank. Proc. helminth. Soc. Wash., 37(1):68-77.

Siddiqi, M.R. 1970. Structure of the oesophague in the classification of the superfamily Tylenchoidea (Nematoda). Indian. J. Nematol., 1:25-43.

Siddiqi, M.R. 1972. On the genus Helicotylenchus Steiner, 1945 (Nematoda : Tylenchida) with description of nine new species. Nematologica, 18(1):74-91.

Siddiqi, M.R. 1979. New nematode genera Plesiodorus (Dolichodorinae), Meiodorus (Meiodorinae sub fam. n.) Amplimerlinius (Merliniinae) and Gracilancea (Tylendoridae grad. n.). Nematologica, 22(4):390-416.

Siddiqi, M.R. and Basir, M.A. 1959. On some plant parasitic nematodes occuring in S. India with description of two new species of the genus Tylenchorhynchus Cobb, 1913. Proc. 46th. Indian Sci. Congr. Part IV. Abstr. No. 35.

Singh, S.D. 1971. Studies on the Morphology and systematics of plant and soil nematode mainly from Andhra Pradesh. I Tylenchoidea. J. Helminth., 45(4): 353-369.

Singh, S.P. 1974. A new species of the genus Deladenus Thorne, 1941 and Tylenchorhynchus Cobb, 1913 from Lucknow, India. Indian J. Zoot., 15(3) : 187-192.

Singh, S.P. 1977. Two plant parasitic nematodes of the genus Seinura Fuchs, 1931 (Nematoda : Aphelenchodidae) from Lucknow. Rec. Zool. Surv. India, 72(1/4) : 325-331.

Singh, S.P. and Jain, V.K., 1982. Two new species of plant parasitic nematodes Tylenchus lucknowensis and Tylenchorhynchus Codiaei from Lucknow. Reading in Zoology, 1(2) : 179-185.

Singh, S.P. and Jain, V.K., 1984. Two new species of the genus Pratylenchus Filipjev, 1936 from Lucknow. Bull. Ent., 25(2) : 179-185.

Singh, D.B. and Mishra, S.R., 1976. Pathogenicity and histopathology of _Hoplolaimus_ _indicus_ on Sugarcane. _Nematologica_, _22_: 433 : 346.

Singh, R.V. and Khera, S. 1978. Plant parasitic nematodes from the rhizosphere of vegetable crops around Calcutta. 2. Family Tylenchorhychidae. _Bull_. _Zool_. _Surv_. _India_, _1_(1):25-28.

Sitaramaiah, K., Singh, R.S., Singh, K.P. and Sikora, R.A. 1971. Plant Parasitic and Soil nematodes of India. _Bull_. _Exp_. _Sta_. _U.P_. _agric_. _Univ_. _Pant Nagar_., No. 3, 70 pp.

Sivakumar, C.V. and Muthukrishnan, T.S. 1983, _Tylenchorhynchus_ _sacchari_ Sp.n. (Tylenchorhynchidae : Nematoda). _Indian_ _J_. _Nematol_ (1982), _12_(2) : 393-395.

Southey, J.F., 1973. Identification of _Xiphinema_ species in the Longidoriae. _Manual_ _Worksh_. _Nemato_ _Group_ _Assoc_. _appl_. _Biologists_, 37-58.

Srivastava, A.S., Upadhyay, K.D. and Singh, G. 1974. Effect of root-knot nematode, _Meloidogyne_ _Javanica_ on gram crop. _Indian_ _J_. _Nematol_., 4 : 248-251.

Steiner, G., 1927. _Tylenchus_ _Paratensis_ and various other nemas attacking plants. _Jour_. _Agr_. _Res_. _35_(11) : 961-981.

Steiner, G., 1931. On the status of the nemic genera Aphelenchus Bastian, Pathoaphelenchus Cobb, Paraphelenchus Micoletzky, Parasitaphelenchus Fuchs, Isonchus Cobb, and Seinura Fuchs. J. Wash. Acad. Sci. 21(18) : 468-475.

Steiner, G., 1945. Helicotylenchus, a new genus of plant parasitic nematodes and its relationship to Rotylenchus Filipjev. Proc. helminth. soc. wash. 12:34-38.

Suryawanshi, M.V., 1971a. Studies on Tylenchida (Nematoda) from Marathwada, India, with descriptions of four new species. Nematologica, 17(3) : 393-406.

Suryawanshi, M.V., 1971b. Studies on Aphelenchoidea (Nematoda) from Marathwada, India, with descriptions of three new species and a discussion on the validity of Aphelenchus radicicolus (Cobb, 1913) Steiner, 1931. Nematologica 17(3) : 417-427.

Swarup, G., Sethi, C.L. and Gill, J.S., 1964. Some records of plant parasitic nematodes in India. Curr. Sci., 33 : 593.

Tondon, R.S. and Singh, S.P. 1973. Two plant parasites of two different families of nematodes parasitising lady finger (Abelmoschus esculentus) at Lucknow. Zool. Anz., 191(1/2) : 139-150.

Tarjan, A.C., 1964a. Two american dagger nematode (Xiphinema : Dorylaimidae) associated with citrus, with comments on the variability of X. bakeri Williams, 1961. Proc. helminth. Soc. Wash. 31(1) : 65-76.

Tarjan, A.C., 1973. A synopsis of the genera and species in the Tylenchorhynchinae (Tylenchoidea, Nematoda) Proc. helminth. Soc. Wash. 40(1) : 123-144.

Thorne, G. 1934. Some plant parasitic nemas, with description of three new species. Jour. Agr. Res. 49(8) : 755-769.

Thorne, G., 1937. Notes on free living and plant parasitic nematodes. III. Proc. helminth. soc. wash. 4:16-18.

Thorne, G., 1949. On the classification of the Tylenchida, new order (Nematoda : Phasmida). Proc. helminth. Soc. Wash. 16 : 37-73.

Thorne, G., and Malek, R.B., 1968. Nematodes of the northern great plains. Part I Tylenchida (Nematoda : Secernentea). Tech. Bull. S. Dak. Agric. Exp. Sta., No. 31:111pp.

Upadhyay, K.D., Swarup, G. and Sethi, C.L., 1972. Tylenchorhynchus Vulgaris Sp. n. associated with Maize roots in India, with notes on its embryology and like history. Indian J. Nematol. 2(2) : 129-138.

Wasilewska, L., (1965). Tylenchus Sandneri Sp.n., a new nematode from Poland. (nematoda : Tylenchidae). Bull. Acad. Polon. Sci. Zool. 13:87-89.

William, J.R., 1960. Studies on the nematode soil fauna of Sugarcane fields in Mauritius 4. Tylenchoidea (Partim). Maur. Sugar Ind. Res. Inst. Occ. Paper 4, 30p.

Wu, L.Y., 19689. Five new species of Tylenchus Bastian 1865 (Nematoda : Tylenchidae) form Canadian High Artic-Canad. Journ. Zool. 47 : 1005-1010.

Wu, L.Y., 1970. Genus Ottolenchus n. rank and Ottolenchus Sulcus n.sp. Tylenchidae : Nematoda. Can. J. Zool. 48:249-251.

Wyss, U. 1973. Feeding of Tylenchorhynchus dubius. Nematologica, 19(2) : 125-136.

Yadav, B.S. and Varma, M.K. 1967. New host plants of Xiphinema basiri and X. indicum. Nematologica, B : 469.

Zimmermann, A.W.P., 1898. De nematoden der Koffiew Ortels Deel I.Meded. Pl. Tuin Buitenzorg 27: 1-64.

BIO-ECOLOGY

Allen, M.W. 1955. A review of the nematode genus _Tylenchorhynchus_. _Univ_. _Calif_ _Publ_. _Zool_. 61: 129-166.

Bishop, D.D. 1953. Hatching the contents of Cysts of _Heterodera_ _rostochiensis_ with alternating temperature conditions. Nature, Lond, 172:1108.

Fielding, M.J. and J.P. Hollis 1956. Occurrence of plant parasitic nematodes in Louisiana soils. Plant _Dis_. _Reptr_ 40:403-405.

Griffin, G.D. & Darling, H.M. 1964. An ecological study of _Xiphinema_ _americanum_ Cobb in an ornamental spruce nursery. _Nematologica_ 10, 471-479.

Hoff, J.K. and Mai, W.F. 1964. Influence of Soil depth and sampling date on population levels of _Trichodorus_ _Christiei_. _Phytopathology_, 54: 246-247.

Jones, F.G.W. 1956. Soil population of beet eelworm (_Heterodera_ _Schachtii_ _Schm_.) in relation to cropping. II Microplot and Field Plot results. _Ann_. _appl_. _Biol_. 44:25-56.

Khan, A.M., Adhami, A. & Saxena, S.K. 1971. Population changes of some stylet-bearing nematodes associated with Mango (_Mangifera_ _indica_ L.) _Ind_. _J_. _Nematol_. 1:99-105.

Mukhopadhyaya, M.C. and Prasad, S.K. 1968. Population dynamics of Tylenchorhynchus Nematologica, 14: 404-418.

Norton, D.C. 1978. Ecology of Plant Parasitic nematodes. John Wiley & Sons., NY : 268 pp.

Oostenbrink, M. 1956. Over de involed van verschillende gewassen op de vermeerdering van en de schade door Pratylenchus pratensis en Pratylenchus penetrans (Vermes, Nematoda), met sermelding van een afwijkend moeheidsver schijnsel bij houtige gewassen. Tijdscbr. Plziekt. 62, 189-203.

Pereira, C.M., Santos, L.S. & Susana, M.N. de A. 1974. Seasonal changes in the numbers and stages of Ditylenchus dipsaci (Kuhn) Filipjev, in soil and host plants in Portugal. Nematol. Medit. 1: 91-101.

Richter, E., 1969 Zur Vertikalen Verteilung Von Nematoden in einem Sandboden. Nematologica, 15: 44-54.

Srivastava, A.N. & Sethi, C.L. 1984. Relationship of initial population of Heterodera Zeae with plant growth of Maize and nematode reproduction. Indian J. Nematol. 14:110-114.

Siddiqi, Z.A., Khan, A.M. & Saxena, S.K. 1973. Studies on Tylenchorhynchus brassicae, II - Effect of temperature and moisture on multiplication of nematodes. Ind. Phytopath, 26:139-146.

Wallace, H.R. 1955. Factors influencing the emergence of larvae from cysts of beet eelworm, _Heterodera Schachtii_ Schmidt. _J_. _Helminth_. 29:3-16.

Wallace, H.R. 1963, The biology of Plant parasitic nematodes. The biology of plant parasitic nematodes. Will. Glower and Sons Lond., 21, 49, 57 and 191 p.p.

Winslow, R.D. 1964. Soil nematode population studies. I. The migratory root _Tylenchida_ and other nematodes of the Rothamstes and Woburn six-course rotation. _Pedobiologica_. 4:75-76.

Yuen, Pick-Hoong. 1966. The nematode fauna of the regenerated woodland and grassland of Broodbalk Wilderness. _Nematologica_, 12:195-214.

Zuckerman, B.M., Khera, S. and Pierce, A.R. 1964 Population dynamics of nematodes in Cranberry Soils. _Phytophathology_. 54:654-659.